SURA'S

New Sigaram Thoduvom

TARGET

HIGHER SECONDARY FIRST YEAR

PHYSICS

Volume - 1 & 2

1 Mark Questions & Answers

Salient Features :

- Prepared as per the New Syllabus for the year 2018-19.
- Complete 1 mark questions- Book Back, In-text, Competitive Examination Questions, HOTS with Answers.
- Questions from Govt.Model (GMQP), Quarterly Exam-2018, and First Mid Term Test are incorporated at the respective chapters.
- Given in Chapter-wise sequence.
- Useful for Public Exam 2019.

SURA PUBLICATIONS

Chennai

orders@surabooks.com 9600175757 / 8124201000 / 8124301000

2018-19 *Edition*

ISBN : 978-93-81650-48-6

Code No : SG 170

Head Office:

1620, 'J' Block, 16th Main Road, Anna Nagar, **Chennai - 600 040.**
Phones: 044-26162173, 26161099.

Mobile : 96001 75757 / 81242 01000 / 81243 01000

Whatsapp : 81242 01000

e-mail : orders@surabooks.com
website : www.surabooks.com

For More Information - Contact

Doubts in Our Guides	:	enquiry@surabooks.com
For Order	:	orders@surabooks.com
Contact	:	96001 75757 / 8124301000
Whatsapp	:	8124201000 / 9840926027
Online Site	:	www.surabooks.com

For Free Study Materials Visit http://tnkalvi.in

Our Guides for +1 Standard

- Sura's Tamil
- Sura's English
- Sura's Will to Win English
- Sura's English Workbook
- Sura's Mathematics (EM/TM)
- Sura's Physics (EM/TM)
- Sura's Chemistry (EM/TM)
- Sura's Biology (EM/TM)
- Sura's Computer Science (EM/TM)
- Sura's Commerce (EM/TM)
- Sura's Economics (EM/TM)
- Sura's Accountancy (EM/TM)
- Sura's Business Maths (EM/TM)

Also available Sigaram Thoduvom mini guide (EM/TM) for all Subjects.

TO ORDER WITH US

SCHOOLS and TEACHERS:

We are grateful for your support and patronage to 'SURA PUBLICATIONS'

Kindly prepare your order in your School letterhead and send it to us.

For Orders contact: 81242 01000 / 81243 01000

DIRECT DEPOSIT

A/c Name	: **Sura Publications**
Our A/c No.	: **36550290536**
Bank Name	: **STATE BANK OF INDIA**
Bank Branch	: Padi
IFSC	: SBIN0005083

A/c Name	: **Sura Publications**
Our A/c No.	: **21000210001240**
Bank Name	: **UCO BANK**
Bank Branch	: Anna Nagar West
IFSC	: UCBA0002100

A/c Name	:	**Sura Publications**
Our A/c No.	:	**6502699356**
Bank Name	:	**INDIAN BANK**
Bank Branch	:	Asiad Colony
IFSC	:	IDIB000A098

After Deposit, please send challan and order to our address.
email : orders@surabooks.com / Whatsapp : 81242 01000.

DEMAND DRAFT / CHEQUE

Please send Demand Draft / cheque in favour of '**SURA PUBLICATIONS**' payable at **Chennai**.

The Demand Draft / cheque should be sent with your order in School letterhead.

STUDENTS :

Order via Money Order (M/O) to

SURA PUBLICATIONS

1620, 'J' Block, 16th Main Road, Anna Nagar,
Chennai - 600 040.
Phones : 044-26161088, 26161099.
Mobile : 96001 75757/ 81242 01000/81243 01000.
email : orders@surabooks.com Website : www.surabooks.com

CONTENTS

Volume - 1

Volume - 2

11th STD

PHYSICS

VOLUME - 1

1 Mark

Unit-I Nature of Physical World and Measurement

Textbook Questions

Multiple Choice Questions:

1. **One of the combinations from the fundamental physical constants is $\frac{hc}{G}$. The unit of this expression is**
   (a) Kg^2 (b) m^3 (c) S^{-1} (d) m
   [Ans. (a) Kg^2]

2. **If the error in the measurement of radius is 2%, then the error in the determination of volume of the sphere will be**
   (a) 8% (b) 2% (c) 4% (d) 6%
   [Ans. (d) 6%]

3. **If the length and time period of an oscillating pendulum have errors of 1% and 3% respectively then the error in measurement of acceleration due to gravity is** *[Related to AMPMT 2008]*
   (a) 4% (b) 5% (c) 6% (d) 7%
   [Ans. (d) 7%]

4. **The length of a body is measured as 3.51 m, if the accuracy is 0.01mm, then the percentage error in the measurement is**
   (a) 351% (b) 1%
   (c) 0.28% (d) 0.035% **[Ans. (c) 0.28%]**

3. If force |F|, velocity |V| and time |T| are taken as to fundamental units then the dimensions of mass are

(a) $FV^{-1}T$ (b) $FV^{-1}T$

(c) FVT^{-1} (d) FVT^{-2} **[Ans. (c) FVT^{-1}]**

Hint:

$$F = \frac{mv}{t} \quad [m] = [Fv^{-1}T] \quad \left[\because a = \frac{v}{t}\right]$$

4. The density of a cube is measured by measuring its mass and length of its side. If the maximum error in the measurement of mass ansd length are 5% and 3% respectively, the maxmimum error in the measurement of density is

(a) 9% (b) 8%

(c) 14% (d) 2% **[Ans. (c) 14%]**

Hint:

$$\text{Density } p = \frac{M}{V} = \frac{M}{L^3} \quad \Delta M = 5\%;\ \Delta L = 3\%$$

$$\frac{\Delta P}{P} = \frac{\Delta M}{M} + \frac{\Delta V}{V} \Rightarrow \frac{\Delta P}{P}\% = \left(\frac{\Delta M}{M} + 3.\frac{\Delta L}{L}\right)\%$$

$$\left(\frac{\Delta P}{P}\right)\% = (5\% + 3.3\%)$$

$$= (5 + 9) = 14\%$$

5. Find the value of one AU in 1000 km

(a) 1.5×10^5m (b) 2.5×10^6m

(c) 1.5×10^{11}m (d) 2.5×10^{10}m

[Ans. (a) 1.5×10^5m]

Hint:

$$1\text{ AU} = 1.5 \times 10^{11}\text{m.}$$

$$1\text{ AU in 1000 km} = \frac{1.5 \times 10^{11}\text{ m}}{10^6\text{ m}}$$

$[\because 1000\text{km} = 10^6\text{m}]$

$$= 1.5 \times 10^5\text{m}$$

3. What is the value of one light year in tera metre?

(a) 9.46×10^6 Tm (b) 9.46×10^9 Tm

(c) 9.46×10^2 Tm (d) 9.46×10^3 Tm

[Ans. (d) 9.46×10^3 Tm]

4. The accleration of 20 m/s^2 in km/h^2 is

(a) 2.59×10^5 km/h^2 (b) 1.29×10^5 km/h^2

(c) 2.0×10^3 km/h^2 (d) 3.5×10^5 km/h^2

[Ans. (a) 2.59×10^5 km/h^2]

5. Which device is used for measuring the mass of atoms?

(a) Spectragraph (b) Fermi

(c) Telescope (d) Microscope

[Ans. (a) Spectragraph]

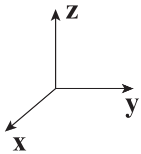
★ ★ ★ ★ ★

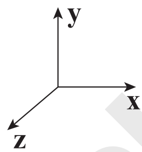
UNIT-2 KINEMATICS

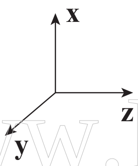
Textbook Questions

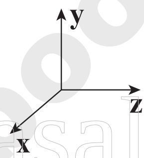
MULTIPLE CHOICE QUESTIONS:

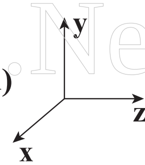
1. Which one of the following Cartesian coordinate systems is not followed in physics?

(a) 

(b) 

(c) 

(d) 

[Ans. (d) 

]

2. Identify the unit vector in the following.

(a) $\hat{i}+\hat{j}$ (b) $\frac{\hat{i}}{\sqrt{2}}$

(c) $\hat{k}-\frac{\hat{j}}{\sqrt{2}}$ (d) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$ **[Ans. (d) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$]**

3. Which one of the following physical quantities cannot be represented by a scalar?

(a) Mass (b) length

(c) momentum (d) magnitude of acceleration

[Ans. (c) momentum]

UNIT-3 LAWS OF MOTION

Textbook Questions

MULTIPLE CHOICE QUESTIONS:

1. **When a car takes a sudden left turn in the curved road, passengers are pushed towards the right due to** *(QY. - 2018)*
   (a) inertia of direction (b) inertia of motion
   (c) inertia of rest (d) absence of inertia
   [Ans. (a) inertia of direction]

2. **An object of mass m held against a vertical wall by applying horizontal force F as shown in the figure. The minimum value of the force F is** *(IIT JEE 1994)*
   (a) Less than mg (b) Equal to mg
   (c) Greater than mg (d) Cannot determine
   [Ans. (c) Greater than mg]

3. **A vehicle is moving along the positive *x* direction, if sudden brake is applied, then**
   (a) frictional force acting on the vehicle is along negative x direction
   (b) frictional force acting on the vehicle is along positive x direction
   (c) no frictional force acts on the vehicle
   (d) frictional force acts in downward direction
   [Ans. (a) frictional force acting on the vehicle is along negative x direction]

4. **A book is at rest on the table which exerts a normal force on the book. If this force is considered as reaction force, what is the action force according to Newton's third law?**
   (a) Gravitational force exerted by Earth on the book
   (b) Gravitational force exerted by the book on Earth
   (c) Normal force exerted by the book on the table
   (d) None of the above
   [Ans. (c) Normal force exerted by the book on the table]

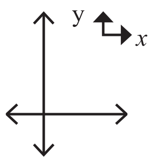
5. Two masses m_1 and m_2 are experiencing the same force where $m_1 < m_2$. The ratio of their acceleration $\frac{a_1}{a_2}$ is

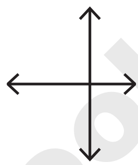
(a) 1 (b) less than 1

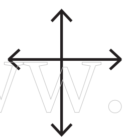
(c) greater than 1 (d) all the three cases

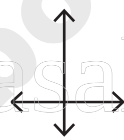
[Ans. (c) greater than 1]

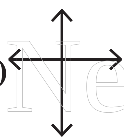
6. Choose appropriate free body diagram for the particle experiencing net acceleration along negative *y* direction. (Each arrow mark represents the force acting on the system).

(a) 

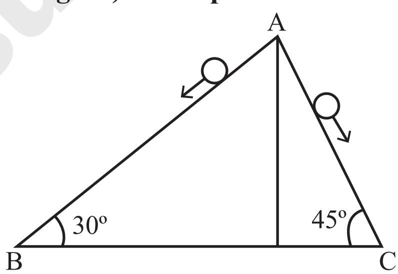
(b) 

(c) 

(d) 

[Ans. (c)  **]**

7. A particle of mass m sliding on the smooth double inclined plane (shown in figure) will experience



(a) greater acceleration along the path AB

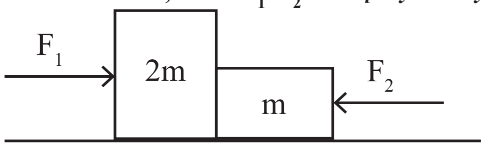
(b) greater acceleration along the path AC

(c) same acceleration in both the paths

(d) no acceleration in both the paths

[Ans. (b) greater acceleration along the path AC]

8. Two blocks of masses m and 2m are placed on a smooth horizontal surface as shown. In the first case only a force F_1 is applied from the left. Later only a force F_2 is applied from the right. If the force acting at the interface of the two blocks in the two cases is same, then F_1:F_2 is *[Physics Olympiad 2016]*



(a) 1 : 1 (b) 1 : 2
(c) 2 : 1 (d) 1 : 3 **[Ans. (c) 2 : 1]**

9. Force acting on the particle moving with constant speed is *(F.M.T - 2018)*

(a) always zero (b) need not be zero
(c) always non zero (d) cannot be concluded

[Ans. (b) need not be zero]

10. An object of mass m begins to move on the plane inclined at an angle θ. The coefficient of static friction of inclined surface is μ_s. The maximum static friction experienced by the mass is *(QY. - 2018)*

(a) mg (b) $\mu_s mg$
(c) $\mu_s mg \sin\theta$ (d) $\mu_s mg \cos\theta$

[Ans. (d) $\mu_s mg \cos\theta$]

11. When the object is moving at constant velocity on the rough surface,

(a) net force on the object is zero
(b) no force acts on the object
(c) only external force acts on the object
(d) only kinetic friction acts on the object

[Ans. (a) net force on the object is zero]

12. When an object is at rest on the inclined rough surface,

(a) static and kinetic frictions acting on the object is zero
(b) static friction is zero but kinetic friction is not zero
(c) static friction is not zero and kinetic friction is zero
(d) static and kinetic frictions are not zero

[Ans. (c) static friction is not zero and kinetic friction is zero]

13. The centrifugal force appears to exist
(a) only in inertial frames
(b) only in rotating frames
(c) in any accelerated frame
(d) both in inertial and non-inertial frames

[Ans. (b) only in rotating frames]

14. Choose the correct statement from the following
(a) Centrifugal and centripetal forces are action reaction pairs
(b) Centripetal forces is a natural force
(c) Centrifugal force arises from gravitational force
(d) Centripetal force acts towards the center and centrifugal force appears to act away from the center in a circular motion

[Ans. (d) Centripetal force acts towards the center and centrifugal force appears to act away from the center in a circular motion]

15. If a person moving from pole to equator, the centrifugal force acting on him
(a) increases (b) decreases
(c) remains the same
(d) increases and then decreases **[Ans. (a) increases]**

In-Text Questions

1. Physical independence of force is a consequence of
(a) III law of motion (b) I law
(c) II law (d) All **[Ans. (b) I law]**

2. Action and reaction
(a) act on two different objects
(b) have opposite direction
(c) have equal magnitude
(d) all of these **[Ans. (d) all of these]**

Board expected Questions

1. **A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane. It follows that**
   (a) Its acceleration is constant
   (b) Its velocity is constant
   (c) Its K.E. is constant
   (d) It moves in a straight line **[Ans. (c) Its K.E. is constant]**

2. **A car when passes through a bridge exerts a force on it which is equal to**
   (a) $mg + \frac{Mv^2}{r}$ (b) $\frac{Mv^2}{r}$
   (c) $Mg - \frac{Mv^2}{r}$ (d) none **[Ans. (c) $Mg - \frac{Mv^2}{r}$]**

3. **A bullet is fired from a rifle. If the rifle recoils freely, then the K.E. of the rifle is**
   (a) Less than that of the bullet.
   (b) Equal or less than that of the bullet.
   (c) More than that of the bullet.
   (d) Same as that of the bullet.
   [Ans. (a) Less than that of the bullet.]

4. **When milk is churned, cream gets separated due to**
   (a) Centripetal force (b) Centrifugal force
   (c) Frictional force (d) Gravitational force
   [Ans. (b) Centrifugal force]

5. **If μs is Coefficient of static friction and μk is coefficient of kinetic friction then**
   (a) There is no relation between μs and μk
   (b) $\mu s > \mu k$
   (c) $\mu s = \mu k$
   (d) $\mu s < \mu k$ **[Ans. (b) $\mu s > \mu k$]**

6. Swimming is possible on account of

(a) I law of motion (b) II law

(c) III law (d) Newton's law of gravitation

[Ans. (c) III law]

7. A body whose momentum is constant must have constant

(a) Force (b) Acceleration

(c) Velocity (d) All **[Ans. (c) Velocity]**

8. Co-efficient of restitution, for an eleastic collision is ______

Q.T.-2018

(a) e = –1 (b) e = 0

(c) e = 1 (d) e = 2 **[Ans. (c) e = 1]**

★ ★ ★ ★ ★

Unit-4 Work, Energy and Power

Textbook Questions

Multiple Choice Questions:

1. A uniform force of $\left(2\hat{i}+\hat{j}\right)$ N acts on a particle of mass 1 kg. The particle displaces from position $\left(3\hat{j}+\hat{k}\right)$ m to $\left(5\hat{i}+3\hat{j}\right)$ m. The work done by the force on the particle is ***(AIPMT model 2013)***

(a) 9 J (b) 6 J
(c) 10 J (d) 12 J **[Ans. (c) 10 J]**

2. A ball of mass 1 kg and another of mass 2 kg are dropped from a tall building whose height is 80 m. After, a fall of 40 m each towards Earth, their respective kinetic energies will be in the ratio of ***(AIPMT model 2004)***

(a) $\sqrt{2}:1$ (b) $1:\sqrt{2}$
(c) 2 : 1 (d) 1 : 2 **[Ans. (d) 1 : 2]**

3. A body of mass 1 kg is thrown upwards with a velocity 20 m s^{-1}. It momentarily comes to rest after attaining a height of 18 m. How much energy is lost due to air friction?
(Take $g = 10$ ms^{-2}) ***(AIPMT 2009)***

(a) 20 J (b) 30 J
(c) 40 J (d) 10 J **[Ans. (a) 20 J]**

4. An engine pumps water continuously through a hose. Water leaves the hose with a velocity *v* and *m* is the mass per unit length of the water of the jet. What is the rate at which kinetic energy is imparted to water ? ***(AIPMT 2009)***

(a) $\frac{1}{2}mv^2$ (b) mv^3

(c) $\frac{3}{2}mv^2$ (d) $\frac{5}{2}mv^2$

The answer is $\frac{1}{2}$ mv^3 (It is not given in the options).

Mass of water flowing out per unit length is mv.

$\therefore$ Rate of K.E. per second = $\frac{1}{2}(mv)v^2 = \frac{1}{2}$ mv^3.

5. **A body of mass 4 m is lying in *xy*-plane at rest. It suddenly explodes into three pieces. Two pieces each of mass *m* move perpendicular to each other with equal speed *v*. The total kinetic energy generated due to explosion is** ***(AIPMT 2014)***

(a) mv^2 (b) $\frac{3}{2}mv^2$

(c) $2\,mv^2$ (d) $4\,mv^2$

[Ans. (b) $\frac{3}{2}mv^2$]

6. **The potential energy of a system increases, if work is done**

(a) by the system against a conservative force

(b) by the system against a non-conservative force

(c) upon the system by a conservative force

(d) upon the system by a non- conservative force

[Ans. (a) by the system against a conservative force]

7. **What is the minimum velocity with which a body of mass m must enter a vertical loop of radius R so that it can complete the loop?**

(a) $\sqrt{2gR}$ (b) $\sqrt{3gR}$

(c) $\sqrt{5gR}$ (d) $\sqrt{gR}$ **[Ans. (c) $\sqrt{5gR}$]**

8. **The work done by the conservative force for a closed path is ________** ***(QY. - 2018)***

(a) always negative (b) zero

(c) always positive (d) not defined **[Ans. (b) zero]**

9. **If the linear momentum of the object is increased by 0.1%, then the kinetic energy is increased by**

(a) 0.1 % (b) 0.2 %

(c) 0.4 % (d) 0.01 % **[Ans. (b) 0.2 %]**

10. If the potential energy of the particle is $\alpha - \frac{\beta}{2}x^2$ then force experienced by the particle is

(a) $F = \frac{\beta}{2}x^2$ (b) $F = \beta x$

(c) $F = -\beta x$ (d) $F = -\frac{\beta}{2}x^2$ **[Ans. (c) $F = -\beta x$]**

11. A wind-powered generator converts wind energy into electric energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to,

(a) v (b) v^2

(c) v^3 (d) v^4 **[Ans. (c) v^3]**

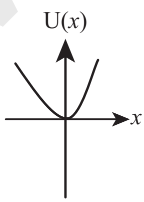
12. Two equal masses m_1 and m_2 are moving along the same straight line with velocities $5ms^{-1}$ and $-9\ ms^{-1}$ respectively. If the collision is elastic, then calculate the velocities after the collision of m_1 and m_2, respectively

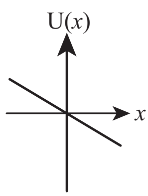
(a) $-4ms^{-1}$ and $10\ ms^{-1}$ (b) $10ms^{-1}$ and $0\ ms^{-1}$

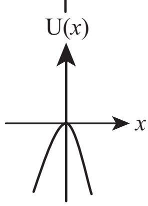
(c) $-9ms^{-1}$ and $5\ ms^{-1}$ (d) $5\ ms^{-1}$ and $1\ ms^{-1}$

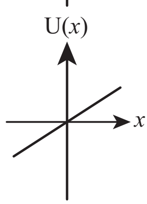
[Ans. (c) $-9ms^{-1}$ and $5\ ms^{-1}$]

13. A particle is placed at the origin and a force F = kx is acting on it (where k is a positive constant). If U (0) = 0, the graph of U(x) versus x will be (where U is the potential energy function) ***(IIT 2004)***

(a) 

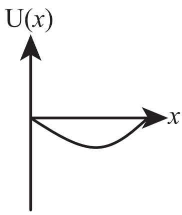
(b) 

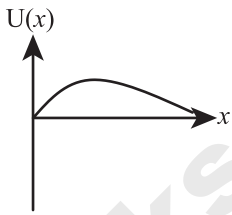
(c) 

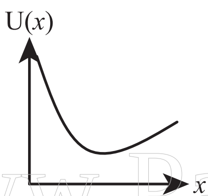
(d) 

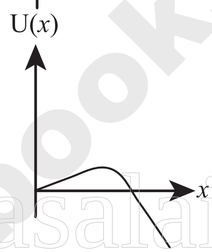
[Ans. (c)]

14. A particle which is constrained to move along x-axis, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = kx + ax^3$. Here, k and a are positive constants. For $x \geq 0$, the functional form of the potential energy U(x) of the particle is *(IIT 2002)*

(a)


(b)


(c)


d)


[Ans. (d)]

15. A spring of force constant k is cut into two pieces such that one piece is double the length of the other. Then, the long piece will have a force constant of

(a) $\frac{2}{3}k$ (b) $\frac{3}{2}k$

(c) $3k$ (d) $6k$ **[Ans. (b) $\frac{3}{2}k$]**

In-Text Questions

1. The work done on an object does not depend upon the

(a) displacement (b) force applied

(c) angle between force and displacement

(d) initial velocity of the object

[Ans. (d) initial velocity of the object]

2. In case of negative work, the angle between the force and displacement is

(a) 0º (b) 90º
(c) 45º (d) 180º **[Ans. (d) 180º]**

3. A body is falling from a height *h*. After it has fallen a height $\frac{h}{2}$ it will possess

(a) only Potential Energy (b) only Kinetic Energy
(c) half potential and half kinetic energy
(d) more kinetic and less potential energy
[Ans. (c) half potential and half kinetic energy]

4. Water stored in a dam possesses

(a) no energy (b) electrical energy
(c) kinetic energy (d) potential energy
[Ans. (d) potential energy]

5. Which one of the following is not the unit of energy?

(a) joule (b) Nm
(c) kW (d) kWh **[Ans. (c) kW]**

6. When a body falls freely towards the earth, then its T.E.

(a) increases (b) decreases
(c) remains constant
(d) first increases and then decreases
[Ans. (c) remains constant]

7. How are joule (J) and ergs related

(a) 1 J = 10^7 erg (b) 1 erg = 10^{-7} J
(c) 1 J = 10^{-7} erg (d) none **[Ans. (b) 1 erg = 10^{-7} J]**

8. A simple pendulum hanging freely and at rest vertical because in that position

(a) Kinetic Energy is zero
(b) Kinetic Energy is minimum
(c) Potential Energy is zero
(d) Potential Energy is minimum
[Ans. (d) Potential Energy is minimum]

5. A gun of mass M fires a bullet of mass m with maximum speed *v*. G.T. *m* < M. The kinetic energy of the gun will be

(a) $\frac{1}{2}mv^2$ (b) $\frac{1}{2}Mv^2$

(c) more than $\frac{1}{2}mv^2$ (d) less than $\frac{1}{2}mv^2$

[Ans. (d) less than $\frac{1}{2}mv^2$]

Hint:

By conservation of momentum $mv = Mv \Rightarrow$

$v = \frac{mv}{M}$ Kinetic energy of the gun $= \frac{1}{2}mv^2$

$= \frac{m}{M}\left(\frac{1}{2}mv^2\right) < \frac{1}{2}mv^2$

6. A particle of mass m_1 is moving with a velocity *v*, and another of mass m_2 is moving with velocity v_2. Both of them have the some momentum but their kinetic energies are E_1 and E_2 respectively. If $m_1 > m_2$ then

(a) $E_1 < E_2$ (b) $\frac{E_1}{E_2} = \frac{m_1}{m_2}$

(c) $E_1 > E_2$ (d) $E_1 = E_2$ **[Ans. (a) $E_1 < E_2$]**

Hint:

K.E. $= \frac{p^2}{2m}$ For same p, E α $\frac{1}{m}$; $\frac{E_1}{E_2} = \frac{m_2}{m_1}$;

$m_1 > m_2 \therefore E_1 < E_2$

7. Two bodies of masses m and 4 m are moving with equal kinetic energies. The ratio of their linear momenta is

(a) 1 : 2 (b) 1 : 4

(c) 4 : 1 (d) 1 : 1 **[Ans. (a) 1 : 2]**

Hint:

p α M (for same kinetic energy) $\frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{m}{4m}} = 1:2.$

8. A particle of mass m moving with velocity v collides with a mass m_2 at rest, then they get embedded. At the instant of collision, velocity of the system

(a) increases (b) decreases

(c) remains constant (d) becomes zero

[Ans. (c) remains constant]

Hint:

[By conservation of momentum $m_1v + m_2 \times 0 = (m_1 + m_2)v^1$

$$v^1 = \frac{m_1}{m_1+m_2}.v. \text{ As } \frac{m_1}{m_1+m_2} < 1, \text{ so, } v^1 > v.$$

velocity decreases at the time of collision]

9. A particle of mass m is being rotated on a vertical circle of radius r. If the speed of particle at the highest point be v, then

(a) $mg = \frac{mv^2}{r}$ (b) $mg > \frac{mv^2}{r}$

(c) $mg < \frac{mv^2}{r}$ (d) $mg \geq \frac{mv^2}{r}$

[Ans. (c) $mg < \frac{mv^2}{r}$]

Hint:

[At highest point $T + mg = \frac{mv^2}{r} \Rightarrow mg < \frac{mv^2}{r}$]

10. The coefficient of restitution e for a perfectly elastic collision is

(a) 1 (b) 0

(c) α (d) –1 **[Ans. (a) 1]**

Hint:

$$|v_1 - v_2| = |u_1 - u_2| \therefore e = \frac{|v_1 - v_2|}{|u_1 - u_2|} = 1.$$

Board expected Questions

1. **A ball moves on a frictionless inclined table without slipping. The work done by the table surface on the ball is**
   (a) positive (b) negative
   (c) zero (d) none **[Ans. (c) zero]**

2. **A car is accelerated on a levelled road and attains a velocity 3 times of its initial velocity. In this process the potential energy of the car**
   (a) does not change
   (b) becomes twice to that of initial
   (c) becomes 4 times to initial
   (d) becomes 16 times to that of initial
   [Ans. (a) does not change]

3. **An iron sphere of mass 8 kg has the same diameter as a copper sphere of mass 4 kg. Both spheres are dropped simultaneously from a tower. When they are 10 m above the ground, they have the same**
   (a) acceleration (b) momenta
   (c) Potential Energy (d) Kinetic Energy
   [Ans. (a) acceleration]

4. **A boy is carrying a school bag of 5 kg mass on his back and moves 100 m on a levelled road. The work done against the gravitational force is ($g = 10\ ms^{-1}$)**
   (a) 5 J (b) 500 J
   (c) 0.5 J (d) zero **[Ans. (d) zero]**

5. **A bullet is fired and gets embedded in a block kept on table. If table is frictionless, then**
   (a) Kinetic Energy gets conserved
   (b) Potential Energy gets conserved
   (c) Momentum conserved
   (d) both (a) and (c) **[Ans. (c) Momentum conserved]**

6. A shell, in flight explodes into four unequal parts. Which is conserved?

(a) potential energy
(b) momentum
(c) kinetic energy
(d) both a and c **[Ans. (b) momentum]**

7. A bullet hits and gets embedded in a solid block resting on a frictionless surface. In this process which is correct?

(a) only momentum is conserved
(b) both momentum and energy are conserved
(c) only kinetic energy is conserved
(d) neither momentum nor energy are conserved

[Ans. (a) only momentum is conserved]

8. Power can be expressed as

(a) $\vec{F}.\vec{v}$ (b) $\frac{1}{2}\vec{F}.v^2$

(c) $\vec{F}.t$ (d) $\vec{F}\times\vec{v}$ **[Ans. (a) $\vec{F}.\vec{v}$]**

★ ★ ★ ★ ★

Unit-5 Motion of System of Particles and Rigid Bodies

Textbook Questions

Multiple Choice Questions:

1. **The center of mass of a system of particles does not depend upon,** ***(AIPMT 1997, AIEEE 2004)***
   (a) position of particles
   (b) relative distance between particles
   (c) masses of particles (d) force acting on particle
   [Ans. (d) force acting on particle]

2. **A couple produces,** ***(AIPMT 1997) (QY. - 2018)***
   (a) pure rotation (b) pure translation
   (c) rotation and translation
   (d) no motion **[Ans. (a) pure rotation]**

3. **A particle is moving with a constant velocity along a line parallel to positive X-axis. The magnitude of its angular momentum with respect to the origin is,** ***(IIT 2002)***
   (a) zero (b) increasing with x
   (c) decreasing with x (d) remaining constant
   [Ans. (d) remaining constant]

4. **A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force 30 N?** ***(NEET 2017)***
   (a) 0.25 rad s^{-2} (b) 25 rad s^{-2}
   (c) 5 m s^{-2} (d) 25 m s^{-2} **[Ans. (b) 25 rad s^{-2}]**

5. **A closed cylindrical container is partially filled with water. As the container rotates in a horizontal plane about a perpendicular bisector, its moment of inertia,**
   (a) increases (b) decreases ***(IIT 1998)***
   (c) remains constant
   (d) depends on direction of rotation. **[Ans. (a) increases]**

6. **A rigid body rotates with an angular momentum L. If its kinetic energy is halved, the angular momentum becomes,**

(AFMC 1998, AIPMT 2015)

(a) L (b) L/2

(c) 2L (d) $L\sqrt{2}$ **[Ans. (d) $L\sqrt{2}$]**

7. **A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about,**

(IIT 2003)

(a) the center point of the circle.

(b) the point on the circumference of the circle.

(c) any point inside the circle.

(d) any point outside the circle

[Ans. (a) the center point of the circle.]

8. **When a mass is rotating in a plane about a fixed point, its angular momentum is directed along,** *(AIPMT 2012)*

(a) a line perpendicular to the plane of rotation

(b) the line making an angle of 45º to the plane of rotation

(c) the radius

(d) tangent to the path

[Ans. (a) a line perpendicular to the plane of rotation]

9. **Two discs of same moment of inertia rotating about their regular axis passing through center and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought in to contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is,** *(NEET 2017)*

(a) $\frac{1}{4} I(\omega_1 - \omega_2)^2$ (b) $I(\omega_1 - \omega_2)^2$

(c) $\frac{1}{8} I(\omega_1 - \omega_2)^2$ (d) $\frac{1}{2} I(\omega_1 - \omega_2)^2$

[Ans. (a) $\frac{1}{4} I(\omega_1 - \omega_2)^2$]

Hint:

Using parallel axes theorem,

$$I_{xx'} = I_1 \text{ (diameter)} + I_2 \text{ (tangential)} + I_3 \text{ (tangential)}$$
$$= 2/3\, mr^2 + (2/3\, mr^2 + mr^2) + (2/3mr^2 + mr^2)$$
$$= 2mr^2 + 2mr^2 = 4mr^2$$

4. A ball rolls without slipping. The radius of gyration of the ball about an axis passing through its center of mass is K. If radius of the ball be R, then the fraction of total energy associated with its rotational energy be

(a) $\frac{K^2 + R^2}{R^2}$ (b) $\frac{K^2}{K^2 + R^2}$

(c) $\frac{K^2}{R^2}$ (d) $\frac{R^2}{K^2 + R^2}$ **[Ans. (b)]**

Hint:

$$E_{rot} = \tfrac{1}{2} I\omega^2 = \tfrac{1}{2} MK^2 \left(V/R\right)^2$$

$$E_{tot} = E_{tran} + E_{rot}$$
$$= \tfrac{1}{2} mv^2 + \tfrac{1}{2} MK^2 \left(V/R\right)^2 = \tfrac{1}{2} MV^2 \left(1 + K^2/R^2\right)$$

$$\frac{E_{rot}}{E_{tot}} = \frac{\frac{1}{2} mv^2 \left(K^2/R^2\right)}{\frac{1}{2} mv^2 \left(1 + K^2/R^2\right)} = \frac{K^2}{K^2 + R^2}$$

5. If there is change of angular momentum from J to 4J in 4S, then the torque is

(a) $\frac{3}{4}$ J (b) 1J (c) $\frac{5}{4}$ J (d) $\frac{4}{3}$ J

[Ans. (a) $\frac{3}{4}$ J]

Hint:

$$\tau = dL/dt = \frac{4J - J}{4} = \frac{3}{4} J$$

6. **The ratio of the radii of gyration of a circular disc to that of circular ring, each of same mass and same radius about their axes is**

(a) $\sqrt{3} : \sqrt{2}$ (b) $1 : \sqrt{2}$

(c) $\sqrt{2} : 1$ (d) $\sqrt{2} : \sqrt{3}$ **[Ans. (b) $1 : \sqrt{2}$]**

Hint:

$$\frac{I_1}{I_2} = \frac{MK_1^2}{MK_2^2} = \frac{\frac{1}{2}MR^2}{MR^2} = \frac{1}{2}$$

$$\therefore \frac{K_1}{K_2} = \frac{1}{\sqrt{2}} = 1 : \sqrt{2}$$

7. **A sphere of radius r is rolling without sliding. What is ratio of rotational K.E and total K.E associated with the sphere?**

(a) $\frac{2}{5}$ (b) $\frac{2}{7}$ (c) 1 (d) $\frac{1}{2}$

[Ans. (b) $\frac{2}{7}$]

Hint:

$$E_{Tot} = E_{trans} + E_{rot} = \frac{1}{2} mv^2 + \frac{1}{2} I\omega^2$$

$$= \frac{1}{2} mv^2 + \frac{1}{2} \times \frac{2}{5} mr^2 \cdot \frac{v^2}{r^2}$$

$$= \frac{1}{2} mv^2 + \frac{2}{10} mv^2 = \frac{7}{10} mv^2$$

$$\frac{E_{rot}}{E_{Tot}} = \frac{\frac{1}{5} mv^2}{\frac{7}{10} mv^2} = \frac{2}{7}$$

8. **A disc is rolling on the inclined plane. What is the ratio of its rotational KE to the total KE?**

(a) 1 : 3 (b) 3 : 1 (c) 1 : 2 (d) 2 : 1

[Ans. (a) 1 : 3]

Hint:

$$E_{Tot} = \frac{1}{2} mv^2 + \frac{1}{2} I\omega^2$$

$$= \frac{1}{2}mv^2 + \frac{1}{2} \times \frac{1}{2}mr^2 \frac{v^2}{r^2}$$

$$= \frac{3}{4}mv^2$$

$$\frac{E_{rot}}{E_{Tot}} = \frac{\frac{1}{4}mv^2}{\frac{3}{4}mv^2} = \frac{1}{3} = 1 : 3$$

9. A sphere rolls down an inclined plane of inclination θ. What is the acceleration as the sphere reaches bottom?

(a) $\frac{5}{7}$ g sin θ (b) $\frac{3}{5}$ g sin θ

(c) $\frac{2}{7}$ g sin θ (d) $\frac{2}{5}$ g sin θ

[Ans. (a) $\frac{5}{7}$ g sin θ]

Hint:

$$a = \frac{g\sin\theta}{1 + \frac{I}{MR^2}}$$ For a sphere, $I = \frac{2}{5}MR^2$

$$\therefore\ a = \frac{5}{7} g \sin\theta.$$

10. Two rings of radii R & nR made from the same wire have the ratio of M.I about an axis passing through their centre equal to 1 : 8. The value of n is

(a) 2 (b) $2\sqrt{2}$ (c) 4 (d) $\frac{1}{2}$

[Ans. (a) 2]

Hint:

$$\left[\frac{I_1}{I_2} = \frac{MR^2}{nM(nR)^2} = \frac{1}{n^3} = \frac{1}{8} \therefore n = 2\right]$$

11. The M.I of a ring about one of its diameter is I. The M.I about a tangent parallel to the diameter is

(a) 4 I (b) 2 I (c) $\frac{3}{2}$ I (d) 3 I

[Ans. (d) 3 I]

6. A dancer on ice spins faster when she folds her arms. This is due to

(a) increase in energy & increase in angular momentum
(b) increase in K.E & decrease in angular momentum
(c) increase in K.E & constant in angular momentum
(d) Decrease in friction at the skates

[Ans. (c) increase in K.E & constant in angular momentum]

7. A bomb travelling in a parabolic path explodes in mid air. The C.M. of fragments will

(a) move vertically downwards
(b) move irregularly
(c) move vertically upwards & then downwards
(d) move in parabolic path the unexploded bomb would have travelled **[Ans. (d) move in parabolic path the unexploded bomb would have travelled]**

8. Consider a system of two identical particles. One is at rest and the other has an acceleration $\vec{a}$. The centre of mass has an acceleration

(a) $\frac{1}{2}\vec{a}$ (b) $\vec{a}$ (c) $2\vec{a}$ (d) zero

[Ans. (a) $\frac{1}{2}\vec{a}$]

9. The least coefficient of friction for an inclined plane inclined at an angle α with horizontal, in order that a solid cylinder will roll down it without slipping?

(a) $\frac{2}{3}\tan\alpha$ (b) $\frac{1}{3}\tan\alpha$
(c) $\frac{2}{7}\tan\alpha$ (d) $\frac{4}{3}\tan\alpha$ **[Ans. (b) $\frac{1}{3}\tan\alpha$]**

10. The direction of angular velocity vector is along

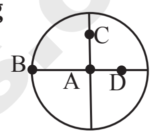
(a) The tangent to the circular path
(b) The outward radius
(c) The inward radius
(d) The axis of rotation **[Ans. (d) The axis of rotation]**

11. When a mass is rotating in a plane about a fixed point its angular momentum is directed along

(a) A line perpendicular to the plane of rotation
(b) The radius
(c) The tangent to the circle
(d) An angle of 45° to the plane of rotation

[Ans. (a) A line perpendicular to the plane of rotation]

12. The M.I of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through



(a) B (b) D (c) A (d) C

[Ans. (a) B]

Hint: d is max so I is max.

13. M.I. of a ring of mass M and radius R about an axis passing through the centre & perpendicular to the plane is I. What is M.I. about its diameter?

(a) I (b) $I/2$ (c) $I/\sqrt{2}$ (d) $I + MR^2$

[Ans. (b) $I/2$]

14. The moment of inertia of a Thin rod about and axis passing through the centre and perpendicular to the length is ______. ***(Q.T.-2018)***

(a) $MI^2/3$ (b) $MI^2/12$
(c) $MI^3/12$ (d) $M(I^2+b^2)/12$ **[Ans. (b) $MI^2/12$]**

15. The centre of mass of a system of particles does not depend upon ***(Q.T.-2018)***

(a) position of particles
(b) relative distance between particles
(c) masses of particles
(d) force acting on particle

[Ans. (d) force acting on particle]

★ ★ ★ ★ ★

VOLUME - 2

UNIT-6 GRAVITATION

Textbook Questions

MULTIPLE CHOICE QUESTIONS:

1. **The linear momentum and position vector of the planet is perpendicular to each other at**
   (a) perihelion and aphelion
   (b) at all points (c) only at perihelion
   (d) no point **[Ans. (a) perihelion and aphelion]**

2. **If the masses of the Earth and Sun suddenly double, the gravitational force between them will**
   (a) remain the same (b) increase 2 times
   (c) increase 4 times (d) decrease 2 times
   [Ans. (c) increase 4 times]

3. **A planet moving along an elliptical orbit is closest to the Sun at distance r_1 and farthest away at a distance of r_2. If V_1 and V_2 are linear speeds at these points respectively. Then the ratio $\frac{v_1}{v_2}$ is** *(NEET 2016)*
   (a) $\frac{r_2}{r_1}$ (b) $\left(\frac{r_2}{r_1}\right)^2$ (c) $\frac{r_1}{r_2}$ (d) $\left(\frac{r_1}{r_2}\right)^2$
   [Ans. (a) $\frac{r_2}{r_1}$]

4. **The time period of a satellite orbiting Earth in a circular orbit is independent of**
   (a) Radius of the orbit
   (b) The mass of the satellite
   (c) Both the mass and radius of the orbit
   (d) Neither the mass nor the radius of its orbit
   [Ans. (b) The mass of the satellite]

Board expected Questions

1. Which one of the following respresents simple hormonic motion?

(a) acculeration = $k\,x$ (b) acculeration = $k_0\,x + k_1x^2$

(c) acceleration = –k ($x + a$)

(d) acceleration = k ($x + a$)

[Ans. (c) acceleration = –k ($x + a$)]

2. Two simple pendulums of time periods 2.0 s & 2.1 s are made to vibrate simultaneously. They are in phase initially, after how may vibrations are there in the same phase?

(a) 21 (b) 25

(c) 30 (d) 35 **[Ans. (a) 21]**

3. The magnitude of acceleration of particle executing SHM at the position of maximum displacement is

(a) zero (b) minimum

(c) maxmium (d) none of these

[Ans. (c) maxmium]

★ ★ ★ ★ ★

UNIT-11 WAVES

Textbook Questions

MULTIPLE CHOICE QUESTIONS:

1. A student tunes his guitar by striking a 120 Hertz with a tuning fork, and simultaneously plays the 4th string on his guitar. By keen observation, he hears the amplitude of the combined sound oscillating thrice per second. Which of the following frequencies is the most likely the frequency of the 4th string on his guitar?

(a) 130 (b) 117 (c) 110 (d) 120

[Ans. (b) 117]

2. A transverse wave moves from a medium A to a medium B. In medium A, the velocity of the transverse wave is 500 ms^{-1} and the wavelength is 5 m. The frequency and the wavelength of the wave in medium B when its velocity is 600 ms^{-1}, respectively are

(a) 120 Hz and 5 m (b) 100 Hz and 5 m

(c) 120 Hz and 6 m (d) 100 Hz and 6 m

[Ans. (d) 100 Hz and 6 m]

3. For a particular tube, among six harmonic frequencies below 1000 Hz, only four harmonic frequencies are given : 300 Hz, 600 Hz, 750 Hz and 900 Hz. What are the two other frequencies missing from this list?

(a) 100 Hz, 150 Hz (b) 150 Hz, 450 Hz

(c) 450 Hz, 700 Hz (d) 700 Hz, 800 Hz

[Ans. (b) 150 Hz, 450 Hz]

4. Which of the following options is correct?

A	B
(1) Quality	(A) Intensity
(2) Pitch	(B) Waveform
(3) Loudness	(C) Frequency

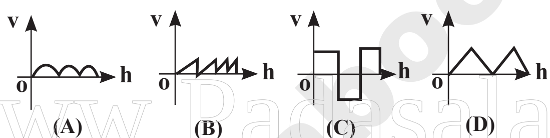
Options for (1), (2) and (3), respectively are

(a) (B),(C) and (A) (b) (C), (A) and (B)

(c) (A), (B) and (C) (d) (B), (A) and (C)

[Ans. (a) (B),(C) and (A)]

5. Compare the velocities of the wave forms given below, and choose the correct option.



where, v_A, v_B, v_C and vD are velocities given in (A), (B), (C) and (D), respectively.

(a) $v_A > v_B > v_D > v_C$ (b) $v_A < v_B < v_D < v_C$

(c) $v_A = v_B = v_D = v_C$ (d) $v_A > v_B = v_D > v_C$

[Ans. (c) $v_A = v_B = v_D = v_C$]

6. A sound wave whose frequency is 5000 Hz travels in air and then hits the water surface. The ratio of its wavelengths in water and air is

(a) 4.30 (b) 0.23

(c) 5.30 (d) 1.23 **[Ans. (a) 4.30]**

13. When temperature increases, the frequency of a tuning fork

(a) increases

(b) decreases

(c) increases or-decreases depending

(d) remains the same **[Ans. (b) decreases]**

14. An observer moves towards a stationary source of sound with a velocity on fifth of the velocity of sound, what is the percentage increase in the apparent frequency?

(a) Zero

(b) 0.5%

(c) 5%

(d) 20% **[Ans. (d) 20%]**

15. A sound absorber attenuates the sound level by 20dB the intensity decreases by a factor of

(a) 100

(b) 1000

(c) 10000

(d) 10 **[Ans. (a) 100]**

Higher Order Thinking Skills (HOTS)

1. The disc of a siren containing 60 holes rotates at a constant speed of 360 rpm. The emitted sound is in unison with a tuning fork of frequency

(a) 10Hz

(b) 360Hz

(c) 216 Hz

(d) 60z **[Ans. (b) 360Hz]**

2. **The equation of a simple harmonic wave is given $y = 5 \sin \frac{\pi}{2}(100t - x)$; where x and y are in meter and time is in seconds. The period of the wave in second will be**

(a) 0.04

(b) 0.01

(c) 1

(d) 5 **[Ans. (a) 0.04]**

3. **If wave $y = A\cos(wt + kx)$ moving alongs x-axis the shapes of pulse at t = 0 and t = 2s**

(a) are different

(b) are same

(c) may not be same

(d) none of these **[Ans. (b) are same]**

4. **$y_1 = 4\sin(wt + kx)$, $y_2 = -4\cos(wt + kx)$, the phase difference is**

(a) $\frac{\pi}{2}$

(b) $\frac{3\pi}{2}$

(c) π

(d) Zero **[Ans. (b) $\frac{3\pi}{2}$]**

5. **A wave equation is $y = 0.01 \sin(100\pi t - kx)$ of wave velocity is 100m/s, its number is equal to**

(a) $1m^{-1}$

(b) $2m^{-1}$

(c) πm^{-1}

(d) $2\pi m^{-1}$ **[Ans. (c) πm^{-1}]**

6. A particle on the tough of a wave art any instant will come to the mean position after a time (7= time period)

(a) $\frac{T}{2}$

(b) $\frac{T}{4}$

(c) T

(d) 2T **[Ans. (b) $\frac{T}{4}$]**

7. An organ pipe of length *l* vibrates in the fundamental mode, the pressure variation is maximum

(a) at the 2 ends

(b) at the distance *l*/2 inside the ends

(c) at the distance *l*/4 inside the ends

(d) at the distance *l*/6 inside the ends

[Ans. (b) at the distance *l*/2 inside the ends]

8. If an experment with sonometer, a tuning fork of frequency 256 Hz resonates with a length of 25cm and another tuning fork resonates with constants the frequency of the second tuning fork is

(a) 163.84Hz

(b) 400 Hz

(c) 320 Hz

(d) 204.8 Hz **[Ans. (b) 400 Hz]**

Board expected Questions

1. **An organ pipe open at one end is vibrating in first overtone and is in resonance with another pipe open at both ends and vibrating in thrid harmonic. The ratio of length of 2 pipes is**
   (a) 1:2
   (b) 4:1
   (c) 8:3
   (d) 3:8 **[Ans. (a) 1:2]**

2. **The fractional change in wavelength of light coming from a star is 0.014%. What is its velocity?**
   (a) 4.2×10^3 m/s
   (b) 3.8×10^8 m/s
   (c) 3.5×10^3 m/s
   (d) 4.2×10^4 m/s **[Ans. (d) 4.2×10^4m/s]**

3. **The waves produced by a motor boat sailing in water are**
   (a) transverse
   (b) longitudinal
   (c) stationary
   (d) longitudinal and transverse
   [Ans. (d) longitudinal and transverse]

★ ★ ★ ★ ★

SURA'S

New Sigaram Thoduvom

TARGET

HIGHER SECONDARY FIRST YEAR

PHYSICS

Volume - I & II

2 & 3 Mark Questions & Answers

Salient Features :

- Prepared as per the New Syllabus for the year 2018-19.
- Complete 2&3 mark questions- Book Back, In-text, Board Expected Questions, HOTS with Answers.
- Questions from Govt.Model (GMQP), Quarterly Exam-2018, and First Mid Term Test are incorporated at the respective chapters.
- Given in Chapter-wise sequence.
- Useful for Public Exam 2019.

SURA PUBLICATIONS

Chennai

2018-19 *Edition*

ISBN : 978-93-81650-6-08

Code No : SG 183

Head Office:

1620, 'J' Block, 16th Main Road, Anna Nagar, **Chennai - 600 040.**
Phones: 044-26162173, 26161099.

Mobile : 96001 75757 / 81242 01000 / 81243 01000

Whatsapp : 81242 01000

e-mail : orders@surabooks.com
website : www.surabooks.com

TO ORDER WITH US

SCHOOLS and TEACHERS:

We are grateful for your support and patronage to 'SURA PUBLICATIONS'

Kindly prepare your order in your School letterhead and send it to us.

For Orders contact: 81242 01000 / 81243 01000

DIRECT DEPOSIT

A/c Name	: **Sura Publications**
Our A/c No.	: **36550290536**
Bank Name	: **STATE BANK OF INDIA**
Bank Branch	: Padi
IFSC	: SBIN0005083

A/c Name	: **Sura Publications**
Our A/c No.	: **21000210001240**
Bank Name	: **UCO BANK**
Bank Branch	: Anna Nagar West
IFSC	: UCBA0002100

A/c Name	:	**Sura Publications**
Our A/c No.	:	**6502699356**
Bank Name	:	**INDIAN BANK**
Bank Branch	:	Asiad Colony
IFSC	:	IDIB000A098

After Deposit, please send challan and order to our address.
email : orders@surabooks.com / Whatsapp : 81242 01000.

DEMAND DRAFT / CHEQUE

Please send Demand Draft / cheque in favour of '**SURA PUBLICATIONS**' payable at **Chennai**.

The Demand Draft / cheque should be sent with your order in School letterhead.

STUDENTS :

Order via Money Order (M/O) to

SURA PUBLICATIONS

1620, 'J' Block, 16th Main Road, Anna Nagar,
Chennai - 600 040.
Phones : 044-26161088, 26161099.
Mobile : 96001 75757/ 81242 01000/81243 01000.
email : orders@surabooks.com Website : www.surabooks.com

Contents

Volume - I

Volume - II

VOLUME - I

Unit-1 Nature of Physical World and Measurement

Textual Questions

Short & Very Answers Questions :

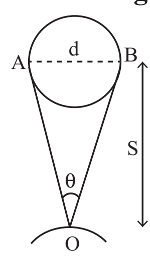
1. Briefly explain the types of physical quantities. **2 MARKS**

Ans. (i) Physical quantities are classified into two types: fundamental or base and derived quantities.

(ii) Fundamental or base quantities are quantities which cannot be expressed in terms of any other physical quantities. For example length, mass, time, electric current, temperature, luminous intensity and amount of substance.

(iii) Quantities that can be expressed in terms of fundamental quantities are called derived quantities. For example, area, volume, velocity, acceleration, force.

2. How will you measure the diameter of the Moon using parallax method? **3 MARKS**



Ans. In diagram, O is the observation point on the earth and d is the diameter of moon.

(i) An astronomical telescope held at O is focussed on moon, the image is observed into moon of a circular disc.

(ii) $\angle AOB = \theta$

S - average distance between moon and the surface of earth.

(iii) As 'S' is very large compared to the diameter, the diameter d of the moon is considered as a circular arc of radius, S.

$d = S \times \theta$.

Hence d can be calculated, when 'S' is known and O is measured.

Accuracy, Δl = 2mm = 0.2 cm

Time for 50 oscillations T = 40 s

resolution ΔT = 1 s

$$\therefore \frac{\Delta g}{g} = \left(\frac{0.2}{20}\right)+2\left(\frac{1}{40}\right)=\frac{0.2}{20}+\frac{2}{40}=\frac{1.2}{20}$$

Percentage error,

$$\frac{\Delta g}{g} \times 100 = \frac{1.2}{20} \times 100 = \pm 6\%$$

% accuracy in g = 6%.

CONCEPTUAL QUESTIONS :

1. Why is it convenient to express the distance of stars in terms of light year (or) parsec rather than in km? **3 MARKS**

Ans. The distances of astronomical objects like stars, planets, etc from the earth are huge. The distance on the earth are relatively small so it can be measured in km.

For Example :

The distance to be next nearest big galaxy Andromeda is 21,000,000,000,000,000,000 km.

i.e. 21×10^{18} km.

This no. is so large that it becomes hard to write and to interpret. So astronomical units like light year, parsec A.U for large distances.

2. Show that a screw gauge of pitch 1 mm and 100 divisions is more precise than a vernier caliper with 20 divisions on the sliding scale. **3 MARKS**

Ans. Least count of screw gauge

$$= \frac{\text{Pitch}}{\text{No. of divisions}}$$

$$= \frac{1}{100} = 0.01 \text{ mm (or) } 0.001\text{cm}$$

Least count of vernier calipers

$$= 1MSD - 1VSD = (1 - {}^{19}\!/_{20})\ MSD$$

$$= \frac{1}{20} = 0.05cm.$$

So screw gauge is more precise than vernier.

3. If humans were to settle on other planets, which of the fundamental quantities will be in trouble? Why? **2 MARKS**

Ans. Time will be in trouble. Time becomes irrelevant. Because day and year based on spinning and revolution of the planet. So each planet has its own year length.

Eg. : Uranus and Neptune move too slow.

4. Having all units in atomic standards is more useful. Explain. **2 MARKS**

Ans. All units in atomic standards are more useful because they never change with time.

5. Why dimensional methods are applicable only upto three quantities? **2 MARKS**

Ans. If a quantity depends on more than three factors having dimensional formula cannot be derived.

Because on equating the powers of M, L & T on either side of the dimensional equation, three equations can be obtained, from which only three unknown dimensions can be calculated.

In-Text Questions

Very Short Answer Questions : **2 MARKS**

1. What is Absolute Error?

Ans. The magnitude of difference between true value and the measured value of a quantity is called absolute error.

$\Delta a_n = a_m - a_n$

4. **Check the correctness of the equation E = mc² using dimensional analysis method.** *[GMQP-2018]*

Ans. Consider the equation, $E = mc^2$

Apply dimensional formula on both sides

$$ML^2T^{-2} = [M] \cdot [LT^{-1}]^2$$

$$ML^2T^{-2} = [M] \cdot [L^2T^{-2}]$$

The equation is dimensionally correct.

5. **Two resistances R_1=(100 ± 3)Ω and R_2=(150±2)Ω are connected in series. What is their equivalent resistance ?**

Ans. $R_1 = 100 \pm 3\ \Omega$; $R_2 = 150 \pm 2\Omega$ *[GMQP-2018]*

Equivalent resistance R = ?

Equivalent resistance $R = R_1 + R_2$

$= (100 \pm 3)+(150 \pm 2) = (100 + 150) \pm (3 + 2)$

R = (250 ± 5) Ω

6. **Find the dimensional formula of hC/G?** *[QY-2018]*

Ans. The dimensional formula for

planck's constant h – $[ML^2T^{-1}]$

c – $[LT^{-1}]$

G – $[M^{-1}L^2T^{-2}]$

$$\frac{hc}{G} = \frac{[ML^2T^{-1}][LT^{-1}]}{[M^{-1}L^3T^{-2}]}$$

$$= [M^2]$$

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. **What is Relative error?**

Ans. The ratio of the mean absolute error to the mean value is called relative error. This is also called as fractional error.

$$\text{Relative error} = \frac{\text{Mean absolute error}}{\text{Mean value}} = \frac{\Delta a_m}{a_m}$$

8. The radius of gold nucleus is 41.3 Fermi. Express its volume in m^3.

Solution: Radius of gold nucleus = 41.3×10^{-15} m

$$\text{Volume } (v) = \frac{4}{3}\pi r^3 = \frac{4}{3} \times 3.14 \times (41.3 \times 10^{-15})^3$$

$$v = 2.95 \times 10^{-40} \text{ m}$$

Short Answer Questions : 3 MARKS

1. What are fundamental units and derived units?

Ans. **Fundamental units:**

The units in which the fundamental quantities are measured are called fundamental units. It is also known as base units.

Derived units:

The units of measurements of all other physical quantities, which can be obtained by a suitable multiplication or division of powers of fundamental units are called derived units.

Example:

$$\text{Unit of speed} = \frac{\text{Unit of distance}}{\text{Unit of time}} = \frac{\text{m}}{\text{s}} = \text{ms}^{-1}$$

ms^{-1} is a derived unit.

2. How can the systematic errors be minimised?

Ans. (i) By choosing the instrument carefully.

(ii) Necessary correction is to be made.

(iii) High precision instrument is to be used.

(iv) Proper setting up of experiments is to be done.

(v) Taking proper precautions is a must, while making observations.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. Why has 'second' been defined in terms of periods of radiations from cesium-133?

Ans. Second has been defined in terms of periods of radiations because

SI unit of stress = $\frac{\text{Force}}{\text{Area}} = \frac{\text{N}}{\text{m}^2} = \text{Nm}^{-2}$

Strain is dimensionless variable.

So, co-efficient of elasticity of a wire is = $\frac{\text{Stress}}{\text{Strain}}$

$$= \frac{3\ \text{Nm}^{-2}}{2\ (\text{No unit})} = 1.5\ \text{Nm}^{-2}$$

Numerical Problems : 3 Marks

1. If mass of an electron is 9.11 × 10^{-31} kg, how many electrons would weigh in 1 mg?

Mass of an electron = 9.11×10^{-31}kg

9.11×10^{-31}kg is the mass of 1 electron

Solution:

$9.11 \times 10^{-31}\text{kg} = 9.11 \times 10^{-31} \times 10^3\ \text{g} = 9.11 \times 10^{-28}\ \text{g}$

$= 9.11 \times 10^{-25}\ \text{mg}$

1mg is the mass of $\frac{1}{9.11 \times 10^{-25}\ \text{mg}}$ electron

$= 0.1097 \times 10^{25}$electrons

$= 1.097 \times 10^{24}$ electrons

1.097×10^{24} electrons would weigh in 1 mg.

2. When the planet Jupiter is at a distance of 824.7 million kilometers from the earth, its angular diameter is measured to be 35.72 of arc. Calculate the diameter of Jupiter.

Solution:

Distance, D = 824.7×10^6 km

$$\theta = 35.72'' = \frac{35.72}{60 \times 60} \times \frac{\pi}{180}\ \text{rad}$$

$\theta \rightarrow$ is angular diameter

Diameter, d = ?

$d = \text{D} \times \theta$

$$= 824.7 \times 10^6 \times \frac{35.72}{60 \times 60} \times \frac{\pi}{180}\ \text{km}$$

$$= 824.7 \times 10^6 \times \frac{35.72}{3600} \times \frac{\pi}{180}\ \text{km}$$

Unit-2 Kinematics

Textual Questions

Short & Very Answers Questions :

1. **Explain what is meant by Cartesian coordinate system?** **2 MARKS**

Ans. At any given instant of time, the frame of reference with respect to which the position of the object is described in terms of position coordinates (x, y, z) (i.e., distances of the given position of an object along the x, y, and z–axes.) is called **"Cartesian coordinate system"**.

2. **Define a vector. Give examples.** **2 MARKS**

Ans. It is a quantity which is described by both magnitude and direction. Geometrically a vector is a directed line segment.

Examples: Force, velocity, displacement, position vector, acceleration, linear momentum and angular momentum.

3. **Define a scalar. Give examples** **2 MARKS**

Ans. It is a property which can be described only by magnitude.

Examples: Distance, mass, temperature, speed and energy.

4. **Write a short note on the scalar product between two vectors.** **2 MARKS**

Ans. (i) The scalar product (or dot product) of two vectors is defined as the product of the magnitudes of both the vectors and the cosine of the angle between them.

(ii) Thus if there are two vectors $\vec{A}$ and $\vec{B}$ having an angle θ between them, then their scalar product is defined as $\vec{A} \cdot \vec{B}$ = cos θ. Here, A and B are magnitudes of $\vec{A}$ and $\vec{B}$.

In-Text Questions

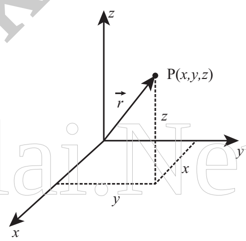
Very Short Answer Questions : 2 MARKS

1. What is meant by frame of reference?

Ans. A co-ordinate system and the position of an object is described relative to it, then such a coordinate system is called frame of reference.

2. What is position vector? Show the position vector for particle in three dimensional motion. Write an expression for this position vector.

Ans. (i) It is a vector which denotes the position of a particle at any instant of time, with respect to some reference frame or coordinate system.



(ii) The position vector $\vec{r}$ of the particle at a point P is given by

$\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$

where x, y and z are components of $\vec{r}$.

3. Define average speed.

Ans. The average speed is defined as the ratio of total path length travelled by the particle in a time interval.

Average speed = total path length / total time

4. Define Time of flight (T_f) of a projectile and derive.

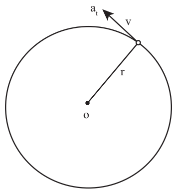
Ans. Time of flight (T_f) Th e total time taken by the projectile from the point of projection till it hits the horizontal plane is called time of flight.

5. Define angular acceleration.

Ans. The rate of change of angular velocity is called angular acceleration.

$$\vec{a} = \frac{d\vec{\omega}}{dt}$$

(v) The tangential acceleration at experienced by an object is circular motion as shown in Figure



Tangential acceleration

Note that the tangential acceleration is in the direction of linear velocity.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. Find the speed of the projectile when it hits the ground?

Ans. (i) When the projectile hits the ground after initially thrown horizontally from the top of tower of height h, the time of flight is

$$t=\sqrt{\frac{2h}{g}}$$

(ii) The horizontal component velocity of the projectile remains the same, i.e $v_x = u$.

(iii) The vertical component velocity of the projectile at time T is

$$v_y = gt = g\sqrt{\frac{2h}{g}} = \sqrt{2gh}$$

(iv) The speed of the particle when it reaches the ground is

$$v=\sqrt{u^2+2gh}$$

2. **(i) Name the quantity which remains unchanged during the flight of an oblique projectile.**

   (ii) If the velocity of projectile is 10 ms^{-1} at what angle to the horizontal should be projected as that it covers maximum horizontal distance?

Ans. (i) Horizontal component of velocity.

(ii) At an angle of 45º to be horizontal.

3. **What are the two quantities which have maximum values when the maximum height attained by the projectile is to the largest?**

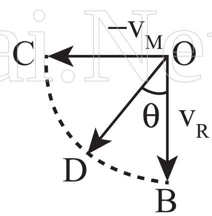
Ans. (i) Vertical component of initial velocity.

(ii) Time of flight.

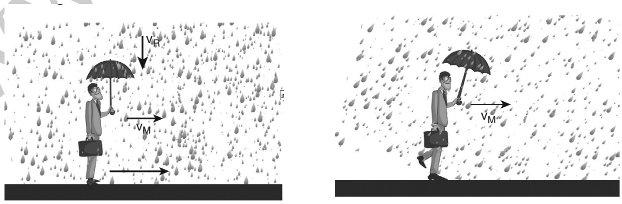
Short Answer Questions : 3 MARKS

4. **A man moving in rain holds an umbrella inclined to the vertical though the rain drops are falling vertically. Why?**

Ans. (i) Consider a person moving horizontally with velocity $\vec{V}_M$. Let rain fall vertically with velocity $\vec{V}_R$.



(ii) An umbrella is held to avoid the rain. Then the relative velocity of the rain with respect to the person is



(iii) $\vec{V}_{RM} = \vec{V}_R - \vec{V}_M = \vec{OB} + \vec{OC} = \vec{OD}$

Which has magnitude

$$V_{RM} = \sqrt{V_R^2 + V_M^2}$$

$\tan\theta = \frac{DB}{OB} = \frac{V_M}{V_R}$ and direction $\theta = \tan^{-1}\left(\frac{V_M}{V_R}\right)$ with the vertical as shown in fig.

(iv) In order to save himself from the rain, he should hold an umbrella at an angle θ with the vertical.

NUMERICAL PROBLEMS : 2 MARKS

1. A train 20 m long is moving with a speed of 40 km/h. In what time shall it cross a bridge of 500 m long?

Solution:

Length of the train S_1 = 20 m

Length of the bridge S_2 = 500 m

Time (t) = ?

Total length $S = S_1 + S_2 = 20 + 500 = 520$ m

$$\text{Speed of train } s = 40\,\text{kmh}^{-1} = 40 \times \frac{5}{18}\,\text{m/s} = 11\text{ m/s}$$

$$\text{Time}(t) = \frac{\text{Distance}}{\text{Speed}} = \frac{520}{11} = 47\,\text{sec}.$$

2. The position of an particle is given by $x = 6t + 2t^3$. Find out that its motion is uniform and non-uniform.

Solution:

The position of an particle $x = 6t + 2t^3$

By differentiating with respect to 't'

$$AB = |A||B|\cos\theta$$

$$\cos\theta = \frac{A \cdot B}{|A||B|}$$

$$A \cdot B = (\hat{i} + 2\hat{j} - k)\cdot(-4\hat{i} + \hat{j} - 2k)$$

$$-4 + 2 + 2k \quad = -4 + 4k = -4 + 4 = 0$$

$$\cos\theta = 0$$

$$\theta = \cos^{-1} 0 = 90°$$

As velocity is time independent, it means that motion is uniform.

UNIT-3 LAWS OF MOTION

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. Explain the concept of inertia. Write two examples each for inertia of motion, inertia of rest and inertia of direction. **3 MARKS**

Ans. The inability of objects to move on its own or change its state of motion is called inertia. Inertia means resistance to change its states.

Examples for Inertia of motion:

(i) A man jumping from moving bus falls forward.

(ii) An athlete runs some distance before taking a long jump.

Examples for Inertia of rest:

(i) Dust particles on a carpet fall if we beat to carpet with a stick.

(ii) Fruits fall down when the branches of a tree is shaken.

Examples for Inertia of direction:

(i) When a stone attached to a string is in whirling motion, and if the string is cut suddenly, the stone will not continue to move in circular motion but moves tangential to the circle.

(ii) The rain drops falling vertically downwards cannot change their direction of motion and so cannot wet us when the umbrella is up.

2. State Newton's second law. *[First Mid-2018]* **2 MARKS**

Ans. The force acting on an object is equal to the rate of change of its momentum.

$$\vec{F} = \frac{d\vec{p}}{dt} = m\vec{a}$$

3. Define one newton. **2 MARKS**

Ans. One Newton is defined as the force which acts on 1 kg of mass to give an acceleration 1 m s^{-2} in the direction of the force.

6. When a person walks on a surface, the frictional force exerted by the surface on the person is opposite to the direction of motion. True or false? **2 MARKS**

Ans. False. The frictional force exerted by the surface is not opposite to the direction of motion.

7. Can the coefficient of friction be more than one? **2 MARKS**

Ans. Yes, $\mu > 1$, friction is stronger than normal force.

8. Can we predict the direction of motion of a body from the direction of force on it? **2 MARKS**

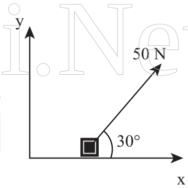
Ans. If an object is thrown vertically upward, the direction of motion is upward, but gravitational force is downward.

9. The momentum of a system of particles is always conserved. True or false? **2 MARKS**

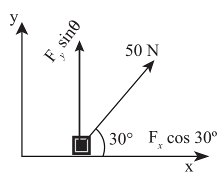
Ans. True. The momentum of a system of particles is always conserved.

NUMERICAL PROBLEMS :

1. A force of 50N act on the object of mass 20 kg shown in the figure. Calculate the acceleration of the object in *x* and *y* directions. **2 MARKS**



Solution:



$$a_x = \frac{F_x \cos 30^\circ}{20} = \frac{50}{20} \times \frac{\sqrt{3}}{2}$$

$$= \frac{25 \times 1.732}{20} = 2.165 \text{ ms}^{-2}$$

$$a_y = \frac{F_y \sin 30^\circ}{20} = \frac{50}{20} \times \frac{1}{2} = 1.25 \text{ ms}^{-2}$$

2. A spider of mass 50 g is hanging on a string of a cob web as shown in the figure. What is the tension in the string? **2 MARKS**

Solution:

T = mg

mass (m) = 50 g = 0.050 kg

g = 9.8 ms^{-2}

T = 0.050 × 9.8 = 0.49 N.

12. A car takes a turn with velocity 50 ms^{-1} on the circular road of radius of curvature 10 m. calculate the centrifugal force experienced by a person of mass 60kg inside the car?

2 MARKS

Ans. Velocity v = 50 ms^{-1}

Radius of curvature r = 10 m

Mass m = 60 kg

$$F = \frac{mv^2}{r} = \frac{60 \times 50 \times 50}{10} = \frac{150000}{10}$$

$$\therefore F = 15,000 \text{ N}$$

13. A long stick rests on the surface. A person standing 10 m away from the stick. With what minimum speed an object of mass 0.5 kg should he thrown so that it hits the stick. (Assume the coefficient of kinetic friction is 0.7).

Ans. The distance of stick from person, s = 10m **2 MARKS**

Mass of the object, m = 0.5 kg

$$\mu_k = f_k/R$$

$$f_k = \mu_k.R \Rightarrow ma = \mu_k.mg$$

$$a = \mu_k.g$$

$$= 0.7 \times 9.8$$

$$a = 6.86 \text{ ms}^{-2}$$

To find minimum velocity

$$v^2 = u^2 + 2\,as$$

$$u = \text{Initial velocity} = 0$$

$$v^2_{min} = 2 \times 6.86 \times 10 = 137.2$$

$$v_{min} = \sqrt{137.2} = 11.71 \text{ ms}^{-1}.$$

In-Text Questions

Very Short Answer Questions : **2 MARKS**

1. State Newton's First Law.

Ans. Every object continues to be in the state of rest or of uniform motion (constant velocity) unless there is external force acting on it.

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. How to verify Newton's third law, using spring balances?

Ans. (i) Two spring balances are attached.

(ii) One end is fixed with rigid support and the other free end pulled by the force.

(iii) Pull one end with same force and note the readings on both the balances.

(iv) Repeat it. We can notice same reading in both balances.

2. Find the acceleration when multiple forces act on the body.

Ans. (i) If multiple forces $\vec{F}_1, \vec{F}_2, \vec{F}_3 \ldots \vec{F}_n$ act on the same body, then the total force $\left(\vec{F}_{net}\right)$ is equivalent to the vectorial sum of the individual forces.

(ii) Their net force provides the acceleration.

$$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \ldots + \vec{F}_n$$

(iii) Newton's second law for this case is

$$\vec{F}_{net} = m\vec{a}$$

In this case the direction of acceleration is in the direction of net force.

3. (i) What are the forces acting on the sliding object?

(ii) What are the factors are determined by these forces?

Ans. (i) Downward gravitational force (mg), Normal force perpendicular to inclined surface (N).

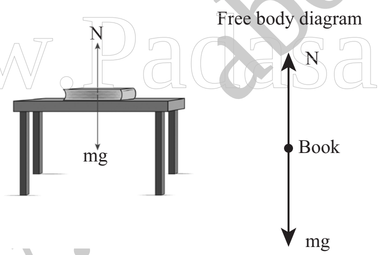
(ii) Acceleration of the object, Speed of the object when it reaches the bottom.

2. A book of mass m is at rest on the table.
(1) What are the forces acting on the book?
(2) What are the forces exerted by the book?
(3) Draw the free body diagram for the book.

Ans. (1) There are two forces acting on the book.
(i) Gravitational force (*mg*) acting downwards on the book.
(ii) Normal contact force (N) exerted by the surface of the table on the book. It acts upwards.

(2) According to Newton's third law, there are two reaction forces exerted by the book.
(i) The book exerts an equal and opposite force (*mg*) on the Earth which acts upwards.
(ii) The book exerts a force which is equal and opposite to normal force on the surface of the table (N) acting downwards.

(3)



Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Why do passengers fall in backward direction when a bus suddenly starts moving from the rest position?

Ans. (i) **Inertia of rest:** When a stationary bus starts to move, the passengers experience a sudden backward push.
(ii) Due to inertia, the body (of a passenger) will try to continue in the state of rest, while the bus moves forward. This appears as a backward push.

Unit-4 Work, Energy and Power

Textual Questions

Short & Very Answers Questions :

1. Explain how the definition of work in physics is different from general perception. **2 MARKS**

Ans. (i) Any activity can generally be called as work.

(ii) But in Physics, work is said to be done by the force when the force applied on a body displaces it.

2. Write the various types of potential energy. Explain the formulae. **3 MARKS**

Ans. **Various types of potential energies.**

Each type is associated with a particular force. For example,

(i) The energy possessed by the body due to gravitational force gives rise to **gravitational potential energy**.

$$U = mgh$$

(ii) The energy due to spring force and other similar forces give rise to **elastic potential energy**.

$$U = \frac{1}{2} k (x_f^2 - x_i^2)$$

(iii) The energy due to electrostatic force on charges gives rise to **electrostatic potential energy**.

$$U = \frac{q_1 q_2}{4\pi \Sigma r}$$

3. Write the differences between conservative and Non-conservative forces. Give two examples each. **3 MARKS** *[QY-2018]*

S.No.	Conservative forces	Non-Conservative forces
1.	Work done is independent of the path	Work done depends upon the path

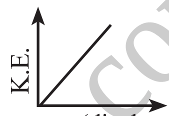
For constant speed $v = u$, then $a = 0$. (a – acceleration)

F = ma $\therefore$ F = zero. i.e. no external force.

W = F.S = 0. So net work done is zero.

4. A car starts from rest and moves on a surface with uniform acceleration. Draw the graph of kinetic energy versus displacement. What information you can get from that graph? **2 MARKS**

Ans. K.E. $= \frac{1}{2}mv^2$



$= \frac{1}{2}m\,(2\,as)$ [From equation of motion II]

$\therefore$K.E. α S.

5. A charged particle moves towards another charged particle. Under what conditions the total momentum and the total energy of the system conserved? **3 MARKS**

Ans. (i) Both charged particles shall be dissimilar charge. (i.e. possitive and negative)

(ii) After collision the charged particles should stick together permanent.

(iii) They should move with common velocity.

In-Text Questions

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. What is the work done by the centripetal force in circular motion?

Ans. In circular motion the centripetal force does not do work on the object moving on a circle as it is always perpendicular to the displacement.

F dr cos 90º [cos 90º = 0]

$\therefore$ W = 0

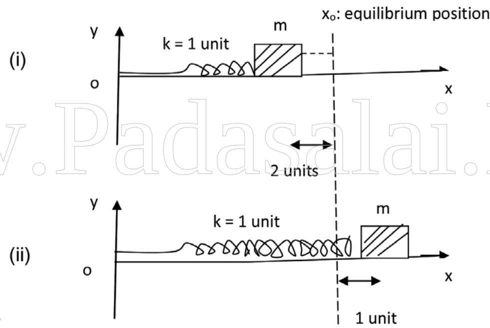
2. Define Potential energy. Write the expression of it. *[GMQP-2018]*

Ans. (i) Potential energy of an object at a point P is defined as the amount of work done by an external force in moving the object at constant velocity from the point O (initial location) to the point P (final location).

(ii) At initial point O potential energy can be taken as zero.

(iii) Mathematically, potential energy is defined as $U = \int \vec{F}_a . d\vec{r}$
where the limit of integration ranges from initial location point O to final location point P.

3. Write the spring force acting on the object at the positions given below (surface is frictionless) *[GMQP-2018]*



Ans. (i) $f = -kx = -1 \times 2 = -2$

(ii) $f = -1 \times 1 = -1$

4. What is power? Give its dimensional formula? *[QY-2018]*

Ans. Power is defined as the rate of work done or energy delivered its dimension is $[ML^2T^{-3}]$ (or)
Power P = workdone (W) / time taken (t).

5. What is the condition for perfect inelastic collision? *[QY-2018]*

Ans. The two objects should stick together permanently after collision such that they move with common velocity.
In that collision linear momentum is conserved but KE is not conserved.

7. What is Non-conservative force? Give example.

Ans. A force is said to be non-conservative if the work done by or against the force in moving a body depends upon the path between the initial and final positions. This means that the value of work done is different in different paths.

(i) Frictional forces are non-conservative forces as the work done against friction depends on the length of the path moved by the body.

(ii) The force due to air resistance, viscous force are also non-conservative forces as the work done by or against these forces depends upon the velocity of motion.

Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. (i) Can Kinetic energy of a system be changed without changing its momentum?

(ii) Can momentum of a system be changed without changing its kinetic energy? Give example.

Ans. (i) Yes, **Example :** When a bomb explodes momentum is conserved but kinetic energy changes.

(ii) Yes, **Example :** In uniform circular motion kinetic energy remains unchanged but lineal momentum changes because of change in the direction of motion.

2. How can an object move with zero acceleration (constant velocity) when the external force is acting on the object?

Ans. (i) It is possible when there is another force which acts exactly opposite to the external applied force.

(ii) They both cancel each other and the resulting net force becomes zero, hence the object moves with zero acceleration.

Unit-5 Motion of System of Particles and Rigid Bodies

Textual Questions

Short & Very Answers Questions :

1. Define center of mass. **2 MARKS**

Ans. The center of mass of a body is defined as a point where the entire mass of the body appears to be concentrated.

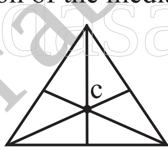
2. Find out the center of mass for the given geometrical structures. **3 MARKS**

(a) Equilateral triangle

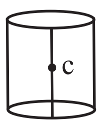
(b) Cylinder

(c) Square

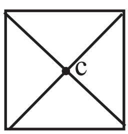
Ans. (a) Point of intersection of the medians



(b) Middle point of the axis.



(c) Point of intersection of diagonals



Numerical Problems :

1. A uniform disc of mass 100g has a diameter of 10 cm. Calculate the total energy of the disc when rolling along a horizontal table with a velocity of 20 cms^{-1} (take the surface of table as reference). 3 MARKS

Solution:

Mass of the disc m = 100 g = 0.1 kg.

Diameter of the disc d = 10 cm

Radius of the disc r = 5 cm = 0.05 m

Rolling with a velocity v = 20 cms^{-1} = 0.20 ms^{-1}

Total energy of the disc E_{Tot} = ?

E_{Tot} = Translational KE. + rotational K.E.

M.I of the disc about its own axis,

$$I = \frac{1}{2} mr^2$$

$$v = r\omega \therefore \omega^2 = \frac{v^2}{r^2}$$

$$\text{Rotational K.E.} = \frac{1}{2} I\omega^2 = \frac{1}{2} \times \left(\frac{1}{2} mr^2\right) \times \left(\frac{v^2}{r^2}\right)$$

$$= \frac{1}{4} mv^2.$$

$$\text{T.E.} = \frac{1}{2} mv^2 + \frac{1}{4} mv^2 = \frac{3}{4} mv^2$$

$$\text{T.E. of the disc } E_{Tot} = \frac{3}{4} \times 0.1 \times 0.20 \times 0.20$$

$$= 0.003 \text{ J}$$

2. A particle of mass 5 units is moving with a uniform speed of $v = 3\sqrt{2}$ units in the XOY plane along the line $y = x + 4$. Find the magnitude of angular momentum. 2 MARKS

Solution:

Equation of line $x - y + 4 = 0$

Mass of particle = 5 units

Speed $v = 3\sqrt{2}$ units

In-Text Questions

Very Short Answer Questions : 2 MARKS

1. What is meant by an internal force & external force?

Ans. Internal forces are the forces acting among the particles within a system that constitute the body. External forces are the forces acting on the particles of a system from outside.

2. What is rigid body?

Ans. A rigid body is the one which maintains its definite and fixed shape even when an external force acts on it.

3. What is the effect of Torque on Rigid Bodies.

Ans. (i) A rigid body which has non-zero external torque (τ) about the axis of rotation would have an angular acceleration (α) about that axis.

(ii) The scalar relation between the torque and angular acceleration is

$$\tau = I\alpha$$

where I is the moment of inertia of the rigid body. The torque in rotational motion is equivalent to the force in linear motion.

4. What is meant by rolling friction?

Ans. When the round object moves, it always tends to roll on any surface which has a coefficient of friction any value greater than zero ($\mu > 0$). The friction that enabling the rolling motion is called rolling friction.

5. A force of $\vec{F} = (4\hat{i} - 3\hat{j} + 5\hat{k})$ N is applied at a point whose position vector is $\vec{r} = (7\hat{i} + 4\hat{j} - 2\hat{k})$ m. Find the torque of force about the origin. ***[GMQP-2018]***

Ans. $\vec{r} \quad = 7\hat{i} + 4\hat{j} - 2\hat{k}$

3.	Velocity, $v = \frac{dx}{dt}$	Angular velocity $\omega = \frac{d\theta}{dt}$
4.	Acceleration, $a = \frac{dv}{dt}$	Angular acceleration $\alpha = \frac{d\omega}{dt}$
5.	Mass, m	Moment of inertia, I
6.	Force, F = ma	Torque, $\tau = I\,\alpha$
7.	Linear momentum, $p = mv$	Angular momentum, $L = I\omega$
8.	Impulse, $F\,\Delta t = \Delta p$	Impulse, $\tau\Delta t = \Delta L$
9.	Work done, $w = F\,s$	Work done, $w = \tau\,\theta$
10.	Kinetic energy $KE = \frac{1}{2}mv^2$	Kinetic energy $KE = \frac{1}{2} I\omega^2$
11.	Power, $P = F\,v$	Power, $P = \tau\omega$

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. State the torque about an axis is independent of the origin.

Ans. (i) The torque of a force about an axis is independent of the choice of the origin as long as it is chosen on that axis itself.

(ii) Let O be the origin on the axis AB, which is the rotational axis of a rigid body. F is the force acting at the point P. Now, choose another point O′ anywhere on the axis.

NUMERICAL PROBLEMS : 2 MARKS

1. A constant couple of 500 Nm turns a wheel of moment of inertia 100 kgm^2 about an axis through its centre. What will be the angular velocity gained by the body after 2 seconds.

Solution:

$$\tau = I\alpha = \frac{I(\omega_2 - \omega_1)}{t}$$

$$\omega_2 - \omega_1 = \frac{\tau\, t}{I} = \frac{500 \times 2}{100} = 5 \times 2 = 10 \text{ rad/s}$$

The gain in angular velocity is 10 rad/s

2. The moment of inertia of a thin rod of mass 'M' and length 'l' about an axis passing through its centre is $\frac{Ml^2}{12}$. Calculate the moment of inertia about a parallel axis through end of rod.

Solution:

According to parallel axis theorem,

$$I = I_0 + mx^2$$

$$= \frac{Ml^2}{12} + M\left(\frac{l}{2}\right)^2 = \frac{Ml^2}{12} + \frac{Ml^2}{4} = Ml^2\left[\frac{1}{12} + \frac{1}{4}\right]$$

$$= Ml^2\left[\frac{1}{3}\right]$$

$$I = \frac{Ml^2}{3}.$$

3. A car of mass 1200 kg is travelling around a circular path of radius 300 m with a constant speed of 54 km/h. Calculate its angular momentum.

Solution:

mass, m = 1200 kg

VOLUME - II

UNIT-6 GRAVITATION

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. **State Kepler's three laws.**

Ans. 1. **Law of orbits:**
Each planet moves around the Sun in an elliptical orbit with the Sun at one of the foci.

2. **Law of area:**
The radial vector (line joining the Sun to a planet) sweeps equal areas in equal intervals of time.

3. **Law of period:**
The square of the time period of revolution of a planet around the Sun in its elliptical orbit is directly proportional to the cube of the semi-major axis of the ellipse.

2. **State Newtons Universal law of gravitation.**

Ans. Newtons law of gravitation states that a particle of mass M_1 attracts any other particle of mass M_2 in the universe with an attractive force. The strength of this force of attraction was found to be directly proportional to the product of their masses and is inversely proportional to the square of the distance between them.

3. **Will the angular momentum of a planet be conserved? Justify your answer.**

Ans. Yes, Because

$$\vec{\tau} = \vec{r} \times \vec{F} = \vec{r} \times \left(-\frac{GM_S M_E}{r^2} \hat{r} \right) = 0$$

$$\text{Since } \vec{r} = r\hat{r}, (\hat{r} \times \hat{r}) = 0$$

$$\text{So, } \vec{\tau} = \frac{d\vec{L}}{dt} = 0.$$

It implies that angular momentum $\vec{L}$ is a constant vector. The angular momentum of the Earth about the Sun is constant throughout the motion.

In-Text Questions

Very Short Answer Questions : 2 Marks

1. If the force of gravity acts on all bodies in proportion to their masses, why does heavy body not all faster than a light body?

Ans. **(i)** If F be the gravitational force on a body of mass m then

$$F = \frac{GMm}{R^2} = mg \qquad \therefore g = \frac{GM}{R^2}$$

(ii) $F \propto m$ but g does not depend on m. So all bodies fall with same speed if there is no air resistance.

2. Acceleration to Newton's law of gravitation the apple and the earth experience equal & opposite forces due to gravitation. But it is the apple falls towards the earth and not vice-versa. Why?

Ans. Acceleration to Newton's III law, the force with which the earth is attracted towards the apple is equal to the force with which earth attracts the apple. However the mass of the earth is extremely large as compared to that of apple. So acceleration of the earth is very small & is not noticeable.

3. Why does a tennis ball bounce higher on a hall than on plains?

Ans. The value of g is less on hills because they are comparatively at a greater distance from the centre of the earth.

$\therefore$ The gravitational pull on the tennis bell is less on hill tops and so it bounces higher on hills than on plains.

4. What is the effect of rotation of the earth on the acceleration due to gravity?

Ans. The acceleration due to gravity decreases due to rotation of the earth. This effect is zero at poles and maximum at the equator.

5. By which law is the Kepler's law of areas identical? Is this Kepler's law kinematic?

Ans. **(i)** The law of conservation of angular momentum.

(ii) Yes. Since Kepler's III law is the relation between distance and time.

$$\frac{M\nu^2}{(R_E + h)} = \frac{GMM_E}{(R_e + h)^2}$$

$$\nu^2 = \frac{GM_E}{(R_E + h)}$$

$$\nu = \sqrt{\frac{GM_E}{(R_E + h)}}$$

As h increases, the speed of the satellite decreases.

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. Explain why high & low tide are formed on seas.

Ans. The gravitational attraction of moon on sea water causes high tides. Tides at one place cause low tides at another. Attraction by sun also causes trodes but only half of the magnitude. Hence on new moon & fall moon days. When both effects add, trodes are very high.

2. A satellite does not need any fuel to aide around the earth. Why?

Ans. The gravitational force between satellite & earth provides the centripetal force required by the satellite to move in a circular orbit.

Short Answer Questions : 3 MARKS

1. Why the gravitational force between the Earth and the Sun is so great while the same force between two small objects is negligible?

Ans. (i) The force experienced by a mass 'm' which is on the surface of the Earth is given by

$$F = \frac{GM_E m}{R_E^2}$$

(ii) M_E-mass of the Earth, m - mass of the object, R_E- radius of the Earth.

Equating Newton's second law, F= mg, to equation we get,

$$m_g = \frac{GM_E m}{R_E^2}$$

$$g = \frac{GM_E}{R_E}$$

(iii) Now the force experienced by some other object of mass M at a distance r from the center of the Earth is given by,

$$F = \frac{GM_E M}{r^2}$$

Using the value of g in equation, the force F will be,

$$F = -gM\frac{R_E^2}{r^2}$$

From this it is clear that the force can be calculated simply by knowing the value of g. It is to be noted that in the above calculation G is not required.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : **2 Marks**

1. A mass M is broken into two parts, m & (M–m). How is m related to M so that the gravitational force between two parts is maximum?

Solution:

Let $m_1 = m$; $m_2 = M - m$

$$R = \frac{G(M-m).m}{r^2} = \frac{G(Mm - m^2)}{r^2}$$

Unit-7 Properties of matter

Textual Questions

Short & Very Answers Questions :

1. Define stress and strain.

Ans. The force per unit area is called as stress.

$$\text{Stress, } \sigma = \frac{\text{Force}}{\text{Area}} = \frac{F}{A}$$

The fractional change in the size of the object, when a force is applied, strain measures the degree of deformation.

$$\text{Strain, } \varepsilon = \frac{\text{change in size}}{\text{original size}} = \frac{\Delta l}{l}$$

2. State Hooke's law of elasticity.

Ans. Hooke's law is for a small deformation, when the stress and strain are proportional to each other.

3. Define Poisson's ratio.

Ans. It is defined as the ratio of relative contraction (lateral strain) to relative expansion (longitudinal strain). It is denoted by the symbol μ.

$$\text{poisson's ratio, } \mu = \frac{\text{lateral strain}}{\text{longitudinal strain}}$$

4. Explain elasticity using intermolecular forces.

Ans. In a solid, interatomic forces bind two or more atoms together and the atoms occupy the positions of stable equilibrium. When a deforming force is applied on a body, its atoms are pulled apart or pushed closer. When the deforming force is removed, interatomic forces of attraction or repulsion restore the atoms to their equilibrium positions. If a body regains its original shape and size after the removal of deforming force, it is said to be elastic and the property is called elasticity.

3. **Why does the velocity increase when liquid flowing in a wider tube enters a narrow tube?**

Ans. This is due to equation of continuity,

$a_1V_1 = a_2V_2$

$\therefore a_1 > a_2 \qquad \therefore V_1 > V_2$

Short Answer Questions : 3 MARKS

1. **How do you differentiate solid, liquid & gas?**

Ans. (i) **Solid:** Atoms or molecules are tightly fixed.

(ii) **Liquid:** Atoms get bound together through various types of bonding.

(iii) **Gas:** Due to the interaction between the atoms, they position themselves at a particular interatomic distance. Their mean positions.

2. **A capillary tube is dipped first in cold water and then in hot water. Comment on the capillary rise in the second case.**

Ans. We know that $h = \dfrac{2s\cos\theta}{r\rho g}$

Surface tension of hot water is less than the surface tension of cold water. Moreover, due to thermal expansion the radius of the capillary tube will increase in hot water. Due to both reasons, the height of capillary rise will be less in hot water as compared to cold water.

Board Expected Questions

Very Short Answer Questions : 2 MARKS

1. **On a hot way, a car is left in sunlight with all windows closed. Explain why it is considerably warmer than outside, after sometime.**

Ans. Glass transmits 50% of heat radiation coming from a hot source like sun but does not allow the radiation from moderately hot bodies to pass through it.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : **2 MARKS**

1. **What is the origin of interatomic force?**

Ans. It arises due to the electrostatic interaction between the nuclei of 2 atoms, their electron clouds of the atom and between the nuclease of one atom & the electron cloud.

2. **What is the origin of intermolecular force?**

Ans. Intermolecular force arises due to the electrostatic interaction between the opposite charged ends of molecular dipoles.

3. **Are the intermolecular forces involved in the formation of liquid & solids different in nature? If yes how?**

Ans. Yes, the intermolecular forces involved in the formation of liquids are attractive in nature while in the formation of solids, the repulsive intermolecular forces are more important.

4. **What is a perfectly elastic body? Give example?**

Ans. If on removal of deforming force, a body completely regains its original configuration, then it is said to be perfectly elastic.

Example: quartic

5. **What does slope of stress versus strain graph give?**

Ans. It gives the modulus of elasticity.

6. **How does youngs modulus change with the rise of temperature?**

Ans. Young's modulus decreases with the rise of temperature.

7. **Why are springs made of steel & not of copper?**

Ans. Young's modulus of steel is greater than that of copper. So steel spring is stretched lesser than a copper spring under the same deforming force. Moreover, steel returns to its original state more quickly than copper on the removal of deforming force.

UNIT-8

HEAT AND THERMODYNAMICS

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. 'An object contains more heat'- is it a right statement? If not why?

Ans. 'Heat' is the energy in transit and which flows from an object at higher temperature to an object at lower temperature. Heat is not a quantity. So the statement **'An object has more heat'** is wrong, instead **'object is hot'** will be appropriate.

2. Obtain an ideal gas law from Boyle's and Charles' law.

Ans. **(i)** Acceleration to Boyle's law $P \alpha \frac{1}{V}$

(ii) Acceleration to Charles' law $V \alpha T$. By combining these two equations we have PV = CT. Here C is a positive constant.

(iii) So we can write the constant C as k times the number of particles N.

Here k is the Boltzmann constant (1.381×10^{-23} JK^{-1}) and it is found to be a universal constant.

So the ideal gas law can be stated as follows

$$PV = NkT$$

3. Define one mole.

Ans. One mole of any substance is the amount of that substance which contains Avogadro number (N_A) of particles (such as atoms or molecules).

4. Define specific heat capacity and give its unit.

Ans. Specific heat capacity of a substance is defined as the amount of heat energy required to raise the temperature of 1kg of a substance by 1 Kelvin or 1°C

$$\Delta Q = ms\Delta T$$

Therefore,

$$s = \frac{1}{m}\left(\frac{\Delta Q}{\Delta T}\right),$$

In-Text Questions

Very Short Answer Questions : 2 MARKS

1. What is meant by heating?

Ans. This process of energy transfer from higher temperature object to lower temperature object is called heating. Due to flow of heat sometimes the temperature of the body will increase or sometimes it may not increase.

2. What is meant by triple point of substance?

Ans. The triple point of a substance is the temperature and pressure at which the three phases (gas, liquid and solid) of that substance coexist in thermodynamic equilibrium.

3. What is steady state?

Ans. The state at which temperature attains constant value everywhere and there is no further transfer of heat anywhere is called steady state.

4. State Prevost theory of heat exchange.

Ans. Prevost theory states that all bodies emit thermal radiation at all temperatures above absolute zero irrespective of the nature of the surroundings

5. Define molar specific heat capacities.

Ans. **(i)** The amount of heat required to raise the temperature of one mole of a substance by 1K or 1°C at constant volume is called molar specific heat capacity at constant volume (C_v).

(ii) If pressure is kept constant, it is called molar specific heat capacity at constant pressure (C_p).

6. What is relegation?

Ans. It is a phenomenon of refraining the water into ice (on the surface of ice formed due to increase in pressure) on removing the increased pressure.

sub in $PV^{\gamma} = K$,

$$P\left(\frac{RT}{P}\right)^{\gamma} = K$$

$$P^{1-\gamma} \cdot T^{\gamma} = \frac{K}{R^{\gamma}} = \text{constant.}$$

$P^{1-\gamma}\,T^{\gamma}$ = constant i.e. $\dfrac{T^{\gamma}}{P^{\gamma-1}}$ = constant.

14. Derive the equation of state $TV^{\gamma-1}$ = constant.

Ans. For one mole of gas PV = RT.

$$\therefore\ P = \frac{RT}{V}.$$

sub. in PV^{γ} = constant.

$$\frac{RT}{V}.V^{\gamma} = \text{constant} \Rightarrow TV^{\gamma-1} = \text{constant}$$

This is the adiabatic relation between volume & temperature of an ideal gas.

Board Expected Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Define the Avogadro's number?

Ans. The Avogadro's number N_A is defined as the number of carbon atoms contained in exactly 12 g of ^{12}C.

2. Define heat capacity.

Ans. 'Heat capacity' is defined as the amount of heat energy required to raise the temperature of the given body from T to $T + \Delta T$.

Heat capacity $S = \dfrac{\Delta Q}{\Delta T}$

3. As air is a bad conductor of heat, why do we not feel warm without clothes?

Ans. This is conductor when we are without clothes air carries away heat from our body due to convection & hence we feel cold.

4. Why is it hotter at the same distance over the top of a fire than in front of it?

Ans. At a point infront of fire, heat is received due to the process of radiation only, while at a point above the fire, heat reaches both due to radiation & convection. Hence the result.

Short Answer Questions : 3 MARKS

1. What is meant by triple point? Give the values of triple point pressure & triple point temperature of water.

Ans. **(i)** It is a point in phase diagram, representing a particular pressure & temperature at which the solid, liquid & vapour phases of the substance can co-exist.

(ii) Triple point pressure of water is 0.46cm of mercury column or 0.066 atm & triple point temperature of water is 273.16K or 0.01°C.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. When a bottle of cold carbonated drink is opened, a slight fog is formed around the opening. Why?

Ans. In opening of bottle, adiabatic expansion of gas causes lowering of temperature.

2. Why air quickly leaving out of a bottom becomes cooler?

Ans. Leaking of air is adiabatic expansion and adiabatic expansion produces cooling.

3. Calorimeters are made of metals not glass. Why?

Ans. This is because metals are good conductors of heat and have low specific heat capacity.

Unit-9

KINETIC THEORY OF GASES

Textual Questions

Short & Very Answers Questions :

1. What is the microscopic origin of pressure?

Ans. With the help of kinetic theory of gases, the pressure is linked to the velocity of molecules.

$$P = \frac{1}{3}\frac{N}{V} mV^{-2}$$

m- mass of a molecule ; N = Avogadro number

V - volume, V^{-2} Avogadro velocity molecules.

2. What is the microscopic origin of temperature?

Ans. Average K.E / molecule

$$K.E = \varepsilon = \frac{3}{2} NkT$$

3. Why moon has no atmosphere?

Ans. The escape speed of gases on the surface of Moon is much less than the root mean square speeds of gases due to low gravity. Due to this, all the gases escape from the surface of the Moon.

4. Write the expression for rms speed, average speed and most probable speed of a gas molecule.

Ans.
$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{ave} = \sqrt{\frac{8RT}{\pi M}} ; \quad V_{mp} = \sqrt{\frac{2RT}{M}}$$

5. What is the relation between the average kinetic energy and pressure?

Ans. The internal energy of the gas is given by

$$U = \frac{3}{2} NkT$$

In-Text Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. On reducing the volume of a gas at constant temperature, the pressure of the gas increases. Explain it on the basis of kinectic theory.

Ans. **(i)** On reducing the volume the number of molecules per unit volume increases.

(ii) Hence a large number collide with the walls of the vessel per second and a larger momentum is transferred to the wall per second. This increases the pressure of the gas.

2. At what temperature does all molecular motion cease? Explain all molecule motion ceases at absolute zero or at 0 K.

Ans. Acceleration to kinectic interpretation of temperature

$$E = \frac{3}{2}k_B T \text{ (or) } T = \frac{2}{3}\cdot\frac{E}{k_B}$$

Absolute temperature × average K.E of molecules.

∴ The temperature = 0 K, average K.E = 0.

3. A box contains equal number of molecules of H_2 & O_2. If there is a fine hole in the box, which gas will leave rapidly? Why?

Ans. $V_{rms} \times \frac{1}{\sqrt{M}}$ so H_2 will leak more rapidly.

Because of its smaller molecular mass.

4. Although the velocity of air molecule is nearly 0.5 *km/s*, yet the smell of scent spreads at a much slower rate. Why?

Ans. **(i)** The air molecule travel along a zig–zag path due to frequent collisions.

(ii) As a result their displacement per unit time is very small. Hence the smell of scent spreads very slowly.

2. What is an ideal gas? Why do the real gases show deviations from ideal behaviour?

Ans. **(i)** A gas which obeys the ideal gas equation $pv = n$RT, at all temperature and pressure is called an ideal or perfect gas.

(ii) Following two assumptions are used to drive the ideal gas equation.

(iii) The size of the gas molecules is negligibly small.

(iv) There is no force of attraction amongst the molecules of a gas.

(v) No real or actual gas fulfills the above conditions. Hence the behaviour of a real gas differs from that of an ideal gas.

(vi) At low pressure and high temperature the above assumptions are valid and some real gases like H_2, O_2, N_2, H_e etc. almost behave like an ideal gel.

Board Expected Questions

Very Short Answer Questions : **2 MARKS**

1. When a gas is heated, its temp. increases. Explain it on the basis of K.T. of gases.

Ans. When a gas is heated, the rms Velocity of its molecule increases. As $V_{rms} \times \sqrt{T}$, so the temperature of the gas increases.

2. On which factors does the average K.E. of gas molecules depend?

Ans. The average K.E of a gas molecule depends only on the absolute temperature of the gas and is directly proportional to it.

3. What type of motion is associated with the molecule of a gas?

Ans. Brownian motion. In this motion any particular molecule will follow a zig–zag path due to be collision with the other molecule or with the walls of the container.

Combining (1) & (2)

$$v \times \frac{T}{p} \quad \text{(or)} \quad v = \text{constant}\ \frac{T}{p} \quad \text{(or)} \quad \frac{pv}{T} = \text{constant}$$

constant is called universal gas constant R.

pv = RT.

For one molecule of a gas, the constant has same value for all gases.

For n moles of a gas $pv = n$RT.

This is perfect (or) ideal gas equation.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 Marks

1. Mention the different ways of increasing the number of molecular collisions per unit time in a gas.

Ans. The numbers of collisions per unit time can be increased by

(i) increasing the temperature of the gas.

(ii) increasing the number of molecules, and

(iii) decreasing the volume of the gas.

UNIT-10 OSCILLATIONS

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. What is meant by periodic and non-periodic motion? Give any two examples, for each motion.

Ans. **1. Periodic motion :**

Any motion which repeats itself in a fixed time interval is known as periodic motion.

Examples : Hands in pendulum clock, swing of a cradle, Heart beat of a person the revolution of the Earth around the Sun, waxing and waning of Moon, etc.

2. Non-Periodic motion :

Any motion which does not repeat itself after a regular interval of time is known as non-periodic motion.

Example : Occurance of Earth quake, eruption of volcano, etc.

2. What is meant by force constant of a spring?

Ans. Force constant is defined as force per unit displacement.

Force constant= force/displacement.

Eg. : (i) Oscillations of a loaded spring

(ii) Vibrations of a turning force.

3. Define time period of simple harmonic motion.

Ans. The time period is defined as the time taken by a particle to complete one oscillation. It is usually denoted by T. For one complete revolution, the time taken is t = T, therefore

$$T = \frac{2\pi}{\omega}$$

4. Define frequency of simple harmonic motion.

Ans. **(i)** The number of oscillations produced by the particle per second is called frequency.

(ii) It is denoted by f. SI unit for frequency is s^{-1} or hertz (In symbol, Hz).

(iii) Angular frequency is related to time period by $f = \frac{1}{T}$

(iv) The number of cycles (or revolutions) per second is called angular frequency.

(v) Angular frequency and frequency are related by $\omega = 2\pi f$

(vi) SI unit for angular frequency is rad s^{-1}.

4. Compute the time period for the following system if the block of mass m is slightly displaced vertically down from its equilibrium position and then released. Assume that the pulley is light and smooth, strings and springs are light.

Solution:

Case (a) :

Pulley is fixed rigidly here. When the mass displace by y and the spring will also stretch by y. Therefore, F = T = ky

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Case (b) :

Mass displace by y, pulley also displaces by y. T = 4ky.

$$T = 2\pi\sqrt{\frac{m}{4k}}$$

In-Text Questions

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. Define simple harmonic motion (S.H.M.)

Ans. S.H.M is the motion in which the restoring force is proportional to the displacement from the mean position and opposes its increase. Such a motion the displacement varies harmonically with time.

2. Why the amplitude of the vibrating pendulum should be small?

Ans. **(i)** When amplitudes of the vibrating pendulum is small then pendulum is small. Here the restoring force F = $mg \sin\theta = mg\,\theta = mg\,x/l$.

(ii) Where x is the displacement of the bob and l is the length of pendulum. Hence F × x. Since F is directed towards mean position.

(iii) Therefore the motion of the bob of simple pendulum will be S.H.M. if θ is small.

3. When a pendulum clock gains time, what adjustments should be made?

Ans. **(i)** When a pendulum clock gains time, it means it has gone fast, it makes more vibrations per day them required.

(ii) This shows that the time period of oscillations has decreased. Therefore, to correct it, the length of pendulum should be properly increased.

4. The displacement of harmonic oscillator is given by $x = \alpha \sin wt + \beta \cos wt$. what is the amplitude of the oscillation?

Ans.
$$x = \alpha \sin wt + \beta \cos wt$$
$$\alpha = r \cos \theta \text{ and } \beta = r \sin \theta$$
$$x = r \cos \theta \sin wt + r \sin \theta \cos wt$$
$$wt = r \sin (wt + \theta)$$

Short Answer Questions : 3 Marks

1. The bob of vibrating simple pendulum is made of ice. How will the period of swing will change when the ice starts melting?

Ans. **(i)** The period of swing of simple pendulum will remains unchanged till the location of the center of gravity of the bob left after melting the ice remains at a fixed distance from the point of suspension.

(ii) If the centre of gravity of ice bob after melting is raised upwards, then the effective length of pendulum decreases and hence the time period of swing decreases. If the centre of gravity of ice shifts on lower side, the time period of swing increases.

Board Expected Questions

Very Short Answer Questions : 2 Marks

1. What is oscillatory motion? Give any two examples.

Ans. If a body moves to and fro repeatedly about a mean position it is called oscillatory motion.

Examples:

(i) Oscillations of a simple pendulum.

(ii) Vibrations of a mass attached to spring.

SHORT ANSWER QUESTIONS : 3 MARKS

1. **State five characteristics of SHM.**

Ans. (i) **Displacement:**
The displacement of a particle executing linear SHM, at an instant is defined as the distance of the particle from the mean position at that instant.

(ii) **Velocity:**
Is defined as the time rate of change of the displacement of the particle at the given instant.

(iii) **Amplitude:**
The maximum displacement on either side of mean position.

(iv) **Acceleration:**
It is defined as the time rate of change of the velocity of the particle at the given instant.

(v) **Time period:**
It is defined as the time taken by the particle executing S.H.M to complete one vibration.

Higher Order Thinking Skills (HOTS)

VERY SHORT ANSWER QUESTIONS : 2 MARKS

1. **Can a motion be oscillatory, but not simple hormonic. If your answer is yes, give an explanation and if not explain why?**

Ans. Yes, when a ball is dropped from a height on a perfectly elastic surface, the motion is oscillatory but not simple harmonic as restoring force F = mg = constant and not Fa – x, which is an essential condition for S.H.M.

2. **Every simple harmonic motion is periodic motion but every periodic motion need not be simple harmonic motion. Do you agree? Give example.**

Ans. Yes, every periodic motion need not be simple harmonic motion explain the motion of the earth round the sun is a period motion, but not simple harmonic motion as the back and forth motion is not taking place.

UNIT-11 WAVES

Textual Questions

SHORT & VERY ANSWERS QUESTIONS :

1. What is meant by waves?

Ans. The disturbance which carries energy and momentum from one point in space to another point in space without the transfer of the medium is known as a wave.

2. Write down the types of waves.

Ans. **(a) Mechanical wave:** Waves which require a medium for propagation are known as mechanical waves.

Examples : sound waves, ripples formed on the surface of water, etc.

(b) Non-mechanical wave: Waves which do not require any medium for propagation are known as non-mechanical waves.

Example : light

Further, waves can be classified into two types

a. Transverse waves

b. Longitudinal waves

3. What are transverse waves? Give one example.

Ans. In transverse wave motion, the constituents of the medium oscillate or vibrate about their mean positions in a direction perpendicular to the direction of propagation (direction of energy transfer) of waves.

Example: light (electromagnetic waves)

4. What are longitudinal waves? Give one example.

Ans. In longitudinal wave motion, the constituent of the medium oscillate or vibrate about their mean positions in a direction parallel to the direction of propagation (direction of energy transfer) of waves.

Example: Sound waves travelling in air.

3. **A sound source and listener are both stationary and a strong wind is blowing. Is there a Doppler effect?**

Ans. Yes. It does not matter whether be sound source or be transmission media are in motion.

4. **In an empty room why is it that a tone sounds louder than in the room having things like furniture etc.**

Ans. Sound is a form of energy. The furniture which act as obstacles absorbs most of energy. So the intensity of sound become low but in empty room, due to the obsence of obstacles the intensity of sound remain mostly same but we feel it louder.

5. **How do animals sense impending danger of hurricane?**

Ans. Some animals are believed to be sensitive to be low frequency sound waves emitted by hurricanes. They can also detect the slight drops in air and water pressure that signal a storm's approach.

6. **Is it possible to realize whether a vessel kept under the tap is about to fill with water?**

Ans. The frequency of the note produced by an air column is inversely proportional to its length. As the level of water in the vessel rises, the length of the air column above it decreases. It produces sound of decreasing frequency. i.e., the sound becames shorter. From the shrillness of sound, it is possible to realize whether the vessel is fulled which water.

$$v_{min} = \ =11.71 \text{ ms}^{-1}$$

In-Text Questions

Very Short Answer Questions : 2 MARKS

1. **What is persistence of hearing?**

Ans. Velocity $= \dfrac{\text{Distance travelled}}{\text{time taken}} = \dfrac{2d}{t}$

$2d = 344 \times 0.1 = 34.4$ m

$d = 17.2$ m.

Board Expected Questions

Very Short Answer Questions : **2 MARKS**

1. Discuss about the formation of waves on stretched string?

Ans. Take a long string and tie one end of the string to the wall. A quick jerk, is 92 a bump (like pulse) is produced in the string. Such a disturbance is sudden and it lasts for a short duration, hence it is known as a wave pulse. If jerks are given continuously then the waves produced are standing waves. Similar waves are produced by a plucked string in a guitar.

2. Mention the important properties which medium should possess for propagation of waves.

Ans. The medium possesses both inertia and elasticity for propagation of waves.

3. Define frequency and time period.

Ans. Frequency is defined as "the number of waves crossing a point per second" It is measured in hertz.

Frequency and time period are inversely related i.e.,

$$T = \frac{1}{f}$$

Time period is defined as the time taken by one wave to cross a point.

4. Give the relation between velocity v, angular frequency ω and wave number λ?

Ans. Velocity, $v = \lambda f \frac{\lambda}{2\pi}(2\pi f) = \frac{(2\pi f)}{2\pi / \lambda} = \omega / k$

5. Define amplitude of the wave.

Ans. An amplitude of the wave is defined as the maximum displacement of the medium with respect to a reference axis (for example in this case x-axis). Here, it is denoted by A.

9. Define angular frequency, wave number and wave vector.

Ans. **(i)** The number of cycles (or revolutions) per unit time is called **angular frequency**. **Angular frequency**, $\omega = \frac{2\pi}{T} = 2\pi f$ (unit is radians/second)

(ii) The number of cycles per unit distance or number of waves per unit distance is called **wave number**.

wave number, $k = \frac{2\pi}{\lambda}$ (unit is radians/meter)

(iii) In two, three or higher dimensional case, the wave number is the magnitude of a vector called wave vector. The points in space of wave vectors are called reciprocal vectors, $\vec{k}$.

Dimensions of $\vec{k}$ is L^{-1}.

Higher Order Thinking Skills (HOTS)

Very Short Answer Questions : 2 MARKS

1. Two astronauts on the surface of the moon cannot talk to each other why?

Ans. Sound waves require material medium for their propagation. As there is no atmosphere on the moon, hence the sound wave cannot propagate on the moon.

2. How does the frequency of a tunning fork change, when the temperature is increased?

Ans. As the temperature increases, the length of the prong of the tuning fork increases. This increases the wavelength of the stationary waves set up in the tunning fork, As frequency, $v \propto \frac{1}{\lambda}$ so frequency of the tunning fork decreases.

3. Explain why we cannot here an echo in a small room?

Ans. For an echo of a simple sound to be heard, the minimum distance between speaker and the walls should be 17m. As the length of a room is less then 17m, so we do not hear on echo.

Short Answer Questions : 3 MARKS

1. Tube A has both ends open, while tube B has one end closed, otherwise they are identical the ratio of fundamental frequency of tubes A & B?

Ans. The fundamental frequency for tube A with both into open is

$$V_B = \frac{V}{2L}$$

The fundamental frequency for tube B with one end closed is

$$V_B = \frac{V}{4L}$$

$$\frac{VA}{VB} = \frac{V/2L}{V/4L} = 2$$

2. The beats are not heard if the difference in frequencies of the two sounding notes is more than 10. Why?

Ans. If the difference in frequencies of the two waves is more than 10, we shall hear more then 10 beats for second. Due to persistence of hearing, our ear is not able to distinguish between two sounds as separate, If the time internal between them is less then $\left(\frac{1}{10}\right)^{th}$ of a second. Hence beats heard will not be distinct if the number of beats produced per second is more than 10.

SURA'S

New Sigaram Thoduvom

TARGET

HIGHER SECONDARY FIRST YEAR

PHYSICS

Volume - I & II

5 Marks Questions & Answers

Salient Features :

- Prepared as per the New Syllabus for the year 2018-19.
- Complete 5 marks questions- Book Back, In-text, Board Expected Questions, HOTS with Answers.
- Questions from Govt.Model (GMQP), Quarterly Exam-2018, and First Mid Term Test are incorporated at the respective chapters.
- Given in Chapter-wise sequence.
- Useful for Public Exam 2019.

SURA PUBLICATIONS

Chennai

2018-19 *Edition*

ISBN : 978-93-88023-68-9

Code No : SG 234

Head Office:

1620, 'J' Block, 16th Main Road, Anna Nagar, **Chennai - 600 040.**
Phones: 044-26162173, 26161099.

Mobile : 96001 75757 / 81242 01000 / 81243 01000

Whatsapp : 81242 01000

e-mail : orders@surabooks.com
website : www.surabooks.com

TO ORDER WITH US

SCHOOLS and TEACHERS:

We are grateful for your support and patronage to 'SURA PUBLICATIONS'

Kindly prepare your order in your School letterhead and send it to us.

For Orders contact: 81242 01000 / 81243 01000

DIRECT DEPOSIT

A/c Name	: **Sura Publications**
Our A/c No.	: **36550290536**
Bank Name	: **STATE BANK OF INDIA**
Bank Branch	: Padi
IFSC	: SBIN0005083

A/c Name	: **Sura Publications**
Our A/c No.	: **21000210001240**
Bank Name	: **UCO BANK**
Bank Branch	: Anna Nagar West
IFSC	: UCBA0002100

A/c Name	: **Sura Publications**
Our A/c No.	: **6502699356**
Bank Name	: **INDIAN BANK**
Bank Branch	: Asiad Colony
IFSC	: IDIB000A098

After Deposit, please send challan and order to our address.
email : orders@surabooks.com / Whatsapp : 81242 01000.

DEMAND DRAFT / CHEQUE

Please send Demand Draft / cheque in favour of '**SURA PUBLICATIONS**' payable at **Chennai**.

The Demand Draft / cheque should be sent with your order in School letterhead.

STUDENTS :

Order via Money Order (M/O) to

SURA PUBLICATIONS
1620, 'J' Block, 16th Main Road, Anna Nagar,
Chennai - 600 040.
Phones : 044-26161088, 26161099.
Mobile : 96001 75757/ 81242 01000/81243 01000.
email : orders@surabooks.com Website : www.surabooks.com

CONTENTS

Volume - I

Volume - II

VOLUME - I

Unit-1 Nature of Physical World and Measurement

Textbook Questions

Long Answer Questions :

1. (i) **Explain the use of screw gauge and vernier caliper in measuring smaller distances.**

   (ii) **Write a note on triangulation method and radar method to measure larger distances.** *[GMQP-2018]*

Ans. **Measurement of small distances:**

(i) The **screw gauge** is an instrument used for measuring accurately the diameter of a thin wire or thickness of a sheet of metal or glass. The dimensions of objects up to a maximum of about 50 mm.

(a) It is used for measuring external dimensions, i.e., diameter.

(b) It can take the smallest measurement of 0.01 mm.

A **vernier caliper** is a versatile instrument for measuring the dimensions of an object namely diameter of a hole or a depth of a hole, i.e., internal & external dimensions.

(ii) For measuring larger distances such as the height of a tree, distance of the Moon or a planet from the Earth. Triangulation method, parallax method and radar method are used.

Triangulation method for the height of an accessible object :

(a) Let AB = h be the height of the tree or tower to be measured. Let C be the point of observation at distance x from B. Place a range finder at C and measure the angle of elevation, $\angle ACB = \theta$ as shown in Figure.

(b) From right-angled triangle ABC, $\tan\theta = \dfrac{AB}{BC} = \dfrac{h}{x}$ (or) height $h = x \tan\theta$.

Numerical Problems

1. **Assuming that the frequency γ of a vibrating string may depend upon (i) applied force (F) (ii) length (*l*) (iii) mass per unit length (m), prove that $\gamma \propto \frac{1}{l}\sqrt{\frac{F}{m}}$ using dimensional analysis.** *(related to JIPMER 2001)*

Ans. $\gamma = K\, l^a\, F^b\, m^c$

K - dimensionless constant of proportionality

a, *b*, *c* - powers of *l*, F, *m*

Dimensional formula of F = MLT^{-2}

Dimensional formula of $m = \frac{\text{mass}}{\text{length}} = \frac{M}{L} = M^1 L^{-1}$

writing dimensions of $\gamma = K\, l^a\, F^b\, m^c$

$$M°L°T^{-1} = L^a (M^1L^1T^{-2})^b [ML^{-1}]^c$$
$$= L^aM^bL^b\, T^{-2b}\, M^cL^{-c}$$
$$= M^{b+c}\, L^{a+b-c}\, T^{-2b}$$
$$M°L°T^{-1} = M^{b+c}\, L^{a+b-c}\, T^{-2b}$$

Applying the principle of homogeneity of dimension

$$b + c = 0 \quad ....①$$
$$a + b - c = 0 \quad ....②$$
$$-2b = -1 \text{ or } \boxed{b = +\frac{1}{2}}$$

From ① $c = -b = -\frac{1}{2}$ $\therefore \boxed{c = -\frac{1}{2}}$

From ② $a + \frac{1}{2} - (-\frac{1}{2}) = 0$ $a + \frac{1}{2} + \frac{1}{2} = 0$ $\therefore \boxed{a = -1}$

Substitute the values *a*, *b*, *c* in $\gamma = K\, l^a\, F^b\, m^c$

$$\gamma = K\, l^{-1}\, F^{\frac{1}{2}}\, m^{-\frac{1}{2}}$$

$$\gamma = \frac{K}{l}.\sqrt{\frac{F}{m}}$$

In-Text Questions

1. The force F acting on a body moving in a circular path depends on mass of the body(m) velocity(v) and radius (r) of the circular path. Obtain the expression for the force by dimensional analysis method. (k = 1). *[First Mid-2018]*

Ans. $F \propto m^a v^b r^c$; $F = k\, m^a v^b r^c$

where k is a dimensionless constant of proportionality. Rewriting the above equation in terms of dimensions and taking $k = 1$, we have

$$[MLT^{-2}] = [M]^a [LT^{-1}]^b [L]^c$$
$$= [M^a L^b T^b L^c]$$
$$[MLT^{-2}] = [M]^a [L^{b+c}] [T^{-b}]$$

Comparing the powers of M, L and T on both sides

$a = 1; b + c = 1 -b = -2$

$2 + c = 1, b = 2$

$a = 1, b = 2$ and $c = -1$

From the above equation we get

$F = m^a v^b r^c$

$F = m^1 v^2 r^{-1}$ or $F = \dfrac{mv^2}{r}$

2. Obtain an expression for the time period T of a simple pendulum. [The time period T depend upon (i) mass l of the bob, (ii) length m of the pendulum and (iii) acceleration due to gravity g at the place where pendulum is suspended. Assume the constant, $k = 2\pi$]. *[GMQP-2018]*

Solution

$T \propto m^a l^b g^c$; $T = k.\, m^a l^b g^c$

Here k is the dimensionless constant. Rewriting the above equation with dimensions.

$[T^1] = [M^a] [L^b] [LT^{-2}]^c$

$[M^0L^0T^1] = [M^a L^{b+c} T^{-2c}]$

Comparing the powers of M, L and T on both sides, $a = 0$, $b + c = 0$, $-2c = 1$

We see that the dimensions of both sides are same. Hence the equation is dimensionally correct.

(iii) To establish the relation among various physical quantities.

If the physical quantity Q depends upon the quantities Q_1, Q_2 and Q_3, i.e., Q is proportional to Q_1, Q_2 and Q_3. Then

$Q \propto Q_1^a Q_2^b Q_3^c$; $Q = k Q_1^a Q_2^b Q_3^c$

where k is a dimensionless constant. When the dimensional formula of Q, Q_1, Q_2 and Q_3 are substituted, then according to the principle of homogeneity, the powers of M, L, T are made equal on both sides of the equation. From this, we get the values of a, b, c.

$$s = ut + \frac{1}{2}at^2$$

Substituting dimensions

$[L] = [LT^{-1}][T] + [LT^{-2}][T^2]$

$[L] = [L] + [L]$

The equation is dimensionally correct.

Board expected Questions

1. Explain propagation of errors in the difference of two quantities and also in the division of two quantities.

Ans. **Errors in the difference of two quantities**.

Let ΔA and ΔB be the absolute errors in the two quantities, A and B, respectively. Then,

Measured value of A $= A \pm \Delta A$

Measured value of B $= B \pm \Delta B$

Consider the difference, $Z = A - B$

The error ΔZ in Z is then given by

$$Z \pm \Delta Z = (A \pm \Delta A) - (B \pm \Delta B) = (A - B) \pm (\Delta A + \Delta B)$$
$$= Z \pm (\Delta A + \Delta B) \text{ (or) } \Delta Z = \Delta A + \Delta B$$

The maximum error in difference of two quantities is equal to the sum of the absolute errors in the individual quantities.

Error in the division or quotient of two quantities

Let ΔA and ΔB be the absolute errors in the two quantities A and B, respectively.

Consider the quotient, $Z = \frac{A}{B}$

The error ΔZ in Z is given by

$$Z \pm Z = \frac{A \pm \Delta A}{B \pm \Delta B} = \frac{A\left(1 \pm \frac{\Delta A}{A}\right)}{B\left(1 \pm \frac{\Delta B}{B}\right)}$$

$$= \frac{A}{B}\left(1 \pm \frac{\Delta A}{A}\right)\left(1 \pm \frac{\Delta B}{B}\right)^{-1}$$

$$\text{or } Z \pm \Delta Z = Z\left(1 \pm \frac{\Delta A}{A}\right)\left(1 \pm \frac{\Delta B}{B}\right)$$

[using $(1 + x)^n \approx 1 + nx$, when $x << 1$]

Dividing both sides by Z, we get,

$$1 \pm \frac{\Delta Z}{Z} = \left(1 \pm \frac{\Delta A}{A}\right)\left(1 \pm \frac{\Delta B}{B}\right)$$

$$= 1 \pm \frac{\Delta A}{A} \pm \frac{\Delta B}{B} \pm \frac{\Delta A}{A} \cdot \frac{\Delta B}{B}$$

As the terms ΔA/A and ΔB/B are small, their product term can be neglected.

The maximum fractional error in Z is given by

$$\frac{\Delta Z}{Z} = \left(\frac{\Delta A}{A} + \frac{\Delta B}{B}\right)$$

The maximum fractional error in the quotient of two quantities is equal to the sum of their individual fractional errors.

★★★

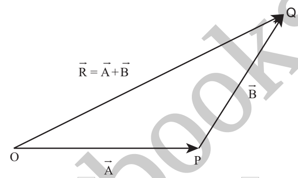
UNIT-2 KINEMATICS

Textbook Questions

1. Explain in detail the triangle law of addition. [OR] Triangle law of vector additon. *[First Mid-2018, QY-2018]*

Ans. (i) Represent the vectors $\vec{A}$ and $\vec{B}$ by the two adjacent sides of a triangle taken in the same order.

(ii) Then the resultant is given by the third side of the triangle taken in the opposite order.



Triangle law of addition

(iii) The head of the first vector $\vec{A}$ is connected to the tail of the second vector $\vec{B}$.

(iv) Let θ be the angle between $\vec{A}$ and $\vec{B}$. Then $\vec{R}$ is the resultant vector connecting the tail of the first vector $\vec{A}$ to the head of the second vector $\vec{B}$.

(v) The magnitude of $\vec{R}$ (resultant) is given geometrically by the length of $\vec{R}$ (OQ) and the direction of the resultant vector is the angle between $\vec{R}$ and $\vec{A}$.

(vi) Thus we write $\vec{R} = \vec{A} + \vec{B}$

$\therefore \overrightarrow{OQ} = \overrightarrow{OP} + \overrightarrow{PQ}$

(v) the magnitude of this resultant acceleration is given by

$$a_R = \sqrt{a_t^2 + \left(\frac{v^2}{r}\right)^2}$$

In-Text Questions

1. Explain the subtraction of vectors.

Ans. (i) For two non-zero vectors $\vec{A}$ and $\vec{B}$ which are inclined to each other at an angle θ, the difference $\vec{A} - \vec{B}$ is obtained as follows. First obtain $-\vec{B}$ as in Figure. The angle between $\vec{A}$ and $-\vec{B}$ is $180 - \theta$.

(ii) The difference $\vec{A} - \vec{B}$ is the same as the resultant of $\vec{A}$ and $-\vec{B}$.

We can write $\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$ and using the equation $\left|\vec{A} + \vec{B}\right| = \sqrt{A^2 + B^2 + 2AB\cos\theta}$, we have

$$\left|\vec{A} - \vec{B}\right| = \sqrt{A^2 + B^2 + 2AB\cos(180 - \theta)}$$

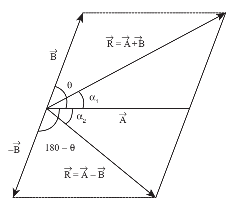
(iii) Since, cos (180 – θ) = – cosθ, we get

Magnitude of averting

$$\Rightarrow \left|\vec{A} - \vec{B}\right| = \sqrt{A^2 + B^2 + 2AB\cos\theta}$$

(iv) Again from the Figure and using an equation similar to equation

$$\tan\alpha = \frac{B\sin\theta}{A + B\sin\theta}$$

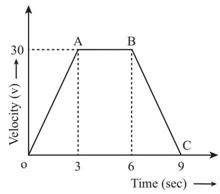


we have

$$\tan\alpha_2 = \frac{B\sin(180^\circ - \theta)}{A + B\cos(180^\circ - \theta)}$$

NUMERICAL PROBLEMS :

1. The velocity-time graph of an object moving along a straight line is as shown.



Calculate distance covered by object between $t = 0$ to $t = 3$ and $t = 0$ to $t = 6$, and velocity is 30 m/s.

(i) **$t = 0$ to $t = 3$:**

velocity at $t = 0$, $u = 0$

velocity at $t = 3$ sec, $v = 30$ m/s

So, from velocity $v = u + at$

$$\text{Acceleration } a = \frac{u}{t} = \frac{30}{3} = 10\,\text{ms}^{-2}$$

So distance covered between 0 to 3 sec

$$s = ut + \frac{1}{2}at^2$$

initial velocity $u = 0$ and $t = 3$

$$s = ut + \frac{1}{2}at^2 = 0 \times 3 + \frac{1}{2} \times 10(3)^2$$

$$= 0 + \frac{1}{2} \times 10 \times 9 = \frac{1}{2} \times 90$$

$$s = 45\,\text{m}$$

From 0 to 3 sec, velocity is same 30 m/s

Total distance covered between 0 to 3 sec.

$= 0 + 45 = 45$ m

(ii) At $t = 3$ sec, $u = 30\ \text{ms}^{-1}$, at $t = 6$ sec, $v = 0$ m/s.

So from, $v = u + at$

$0 = 30 + a \times 3$

$a = -10\ \text{m/s}^2$

c. Time taken to complete one rotation of the earth (T) = ?

New angular speed $\omega_{new} = 1.261 \times 10^{-3}$ rad/s

$$\omega = \frac{2\pi}{T} \Rightarrow T = \frac{2\pi}{\omega} = \frac{6.28}{1.261 \times 10^{-3}}$$

$$= 4.985\ 10^3 \text{ sec}$$

$$T = \frac{4.98510^3}{3600} = 1.4\text{h}$$

Higher Order Thinking Skills (HOTS)

Numerical Problems

1. The position of a particle is given by $r = 2.00t\,\hat{i} - 1.00t^2\,\hat{j} + 3.00\,\hat{k}$ where t is in seconds and the coefficients have the proper units for r to be in metres. Find the velocity and acceleration of a particle then what is the magnitude and direction of velocity of the particle at $t = 2$ s?

Solution:

Given position of the particle is $r = 2.00t\,\hat{i} - 1.00t^2\,\hat{j} + 3.00\,\hat{k}$

Velocity: The rate of change of acceleration is called velocity

$$\text{velocity } v = \frac{dr}{dt} = \frac{d}{dt}(2.00t\,\hat{i} - 1.00t^2\,\hat{j} + 3.00\,\hat{k})$$

$$= \left[2.00\,\hat{i} - 2.00t\,\hat{j} + 0\right] \text{ms}^{-1}$$

$$v = \left[2.00\,\hat{i} - 2.00t\,\hat{j}\right] \text{ms}^{-1}$$

Acceleration: The rate of change of position of the particle is called acceleration

$$\text{Acceleration } a = \frac{dv}{dt} = \frac{d}{dt}(2.00\hat{i} - 2.00t\,\hat{j})$$

$$= 0 - 2.00\,\hat{j} = -2.00\,\hat{j} \text{ ms}^{-2}$$

Unit-3 Laws of Motion

Textbook Questions

1. Prove the law of conservation of linear momentum. Use it to find the recoil velocity of a gun when a bullet is fired from it. *[First Mid-2018]*

Ans. (i) The force on each particle (Newton's second law) can be written as,

$$\vec{F}_{12} = \frac{d\vec{p}_1}{dt} \text{ and } \vec{F}_{21} = \frac{d\vec{p}_2}{dt}$$

(ii) Here $\vec{p}_1$ is the momentum of particle 1 which changes due to the force $\vec{F}_{12}$ exerted by particle 2. Further $\vec{p}_2$ is the momentum of particle 2. This changes due to $\vec{F}_{21}$ exerted by particle 1.

$$\frac{d\vec{p}_1}{dt} = -\frac{d\vec{p}_2}{dt}$$

$$\frac{d\vec{p}_1}{dt} + \frac{d\vec{p}_2}{dt} = 0 \qquad \frac{d}{dt}(\vec{p}_1 + \vec{p}_2) = 0$$

(iii) It implies that $\vec{p}_1 + \vec{p}_2$ = constant vector (always).

(iv) $\vec{p}_1 + \vec{p}_2$ is the total linear momentum of the two particles ($\vec{p}_{tot} = \vec{p}_1 + \vec{p}_2$). It is also called as total linear momentum of the system. Here, the two particles constitute the system.

(v) If there are no external forces acting on the system, then the total linear momentum of the system ($\vec{p}_{tot}$) is always a constant vector.

(iv) As we know the angular velocity $\omega = \frac{2\pi}{T}$

and T = 27.3 days = 27.3 × 24 × 60 × 60 second = 2.358 × 10^6 sec. By substituting these values in the formula for acceleration

$$a_m = \frac{(4\pi^2)(384\times10^6)}{\left(2.358\times10^6\right)^2} = 0.00272 \text{ m s}^{-2}.$$

The centripetal acceleration of Moon towards the Earth is 0.00272 m s^{-2}.

$T \approx 2 \times 10^{20}$N.

In-Text Questions

1. Write an explanation on Newton's laws. ***[QY-2018]***

Ans. (i) Newton's laws are vector laws. The equation $\vec{F} = m\vec{a}$ is a vector equation and essentially it is equal to three scalar equations.

(ii) The acceleration along the *x*-direction depends only on the component of force acting along the *x*-direction.

(iii) $F_y = ma_z$ = The acceleration along the *z*-direction depends only on the component of force acting along the *z*-direction.

(iv) The force acting along *y*-direction cannot alter the acceleration along *x*-direction. In the same way, F_z cannot affect a_y and a_x.

(v) The acceleration experienced by the body at time *t* depends on the force which acts on the body at that instant of time. It does not depend on the force which acted on the body before the time *t*. This can be expressed as

$$\vec{F}(t) = m\vec{a}(t)$$

(vi) Acceleration of the object does not depend on the previous history of the force. For example, when a spin bowler or a fast bowler throws the ball to the batsman, once the ball leaves the hand of the bowler, it experiences only gravitational force and air frictional force.

(vii) The acceleration of the ball is independent of how the ball was bowled (with a lower or a higher speed).

2. Write the Salient features of Static and Kinetic friction.

Ans. ***[QY-2018]***

Static friction	Kinetic friction
It opposes the starting of motion	It opposes the relative motion of the object with respect to the surface
Independent of surface of contact	Independent of surface of contact
μ_s depends on the nature of materials in mutual contact	μ_k depends on nature of materials and temperature of the surface
Depends on the magnitude of applied force	Independent of magnitude of applied force
It can take values from zero to $\mu_s N$	It can never be zero and always equals to $\mu_k N$ whatever be the speed (true <10 m/s)
$f_s^{max} > f_k$	It is less than maximal value of static friction
$\mu_s > \mu_k$	Coefficient of kinetic friction is less than coefficient of static friction.

Board Expected Questions

1. Find the impulse of a constant force and variable force with diagrams.

Ans. (i) For a constant force, the impulse is denoted as $J = F\Delta t$ and it is also equal to change in momentum (Δp) of the object over the time interval Δt.

Impulse is a vector quantity and its unit is Ns.

Higher Order Thinking Skills (HOTS)

1. Explain why a gun recoils when a bullet is fired from it.

Ans. (i) Consider the firing of a gun. Here the system is Gun+bullet. Initially the gun and bullet are at rest, hence the total linear momentum of the system is zero. Let $\vec{p}_1$ be the momentum of the bullet and $\vec{p}_2$ the momentum of the gun before firing. Since initially both are at rest,

$$\vec{p}_1 = 0, \vec{p}_2 = 0.$$

(ii) Total momentum before firing the gun is zero,

$\vec{p}_1 + \vec{p}_2 = 0.$

(iii) According to the law of conservation of linear momentum, total linear momentum has to be zero after the firing also.

(iv) When the gun is fired, a force is exerted by the gun on the bullet in forward direction. Now the momentum of the bullet changes from $\vec{p}_1$ to $\vec{p'}_1$ To conserve the total linear momentum of the system, the momentum of the gun must also change from $\vec{p}_2$ to $\vec{p'}_2$

Due to the conservation of linear momentum, $\vec{p'}_1 + \vec{p'}_2 = 0$. It implies that $\vec{p'}_1 = -\vec{p'}_2$ the momentum of the gun is exactly equal, but in the opposite direction to the momentum of the bullet.

(v) This is the reason after firing, the gun suddenly moves backward with the momentum $\left(-\vec{p}_2\right)$ It is called 'recoil momentum'. This is an example of conservation of total linear momentum.

★ ★ ★

Unit-4 Work, Energy and Power

Textbook Questions

1. Explain with graphs the difference between work done by a constant force and by a variable force.

Ans. **Work done by a constant force :**

(i) When a constant force F acts on a body, the small work done (dW) by the force in producing a small displacement dr is given by the relation,

$$dW = (F\cos\theta)$$

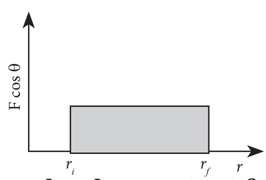
(ii) The total work done in producing a displacement from initial position r_i to final position r_f is,

$$W = \int_{r_i}^{r_f} dW$$

$$W = \int_{r_i}^{r_f} (F\cos\theta)\,dr = (F\cos\theta)$$

$$\int_{r_i}^{r_f} dr = (F\cos\theta)(r_f - r_i)$$

(iii) The graphical representation of the work done by a constant force is shown in Figure. The area under the graph shows the work done by the constant force.



Work done by the constant force

Work done by a variable force :

The work done by the gravitational force on the object is positive.

(i) When the component of a variable force F acts on a body, the small work done (dW) by the force in producing a small displacement dr is given by the relation

$$dW = (F\cos\theta)\,dr$$

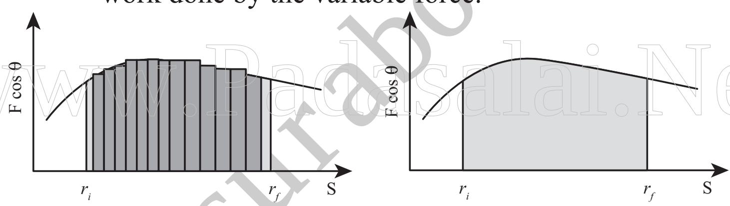
[F cos θ is the component of the variable force F]

where F and θ are variables.

(ii) The total work done for a displacement from initial position r_i to final position r_f is given by the relation,

$$W = \int_{r_i}^{r_f} dW = \int_{r_i}^{r_f} F\cos\theta\,dr \qquad ...(1)$$

(iii) A graphical representation of the work done by a variable force is shown in Figure. The area under the graph is the work done by the variable force.



2. State and explain work energy principle. Mention any three examples for it. ***[GMQP-2018; QY-2018]***

Ans. (i) It states that work done by the force acting on a body is equal to the change produced in the kintic energy of the body.

(ii) Consider a body of mass m at rest on a frictionless horizontal surface.

(iii) The work (W) done by the constant force (F) for a displacement (s) in the same direction is,

$$W = Fs \qquad ...(1)$$

The constant force is given by the equation,

$$F = ma \qquad ...(2)$$

3. A bullet of mass 20 g strikes a pendulum of mass 5 kg. Th e centre of mass of pendulum rises a vertical distance of 10 cm. If the bullet gets embedded into the pendulum, calculate its initial speed.

Ans. Mass of the bullet $m_1 = 20 \text{ g} = 0.02 \text{ kg}$.

Mass of the pendulum $m_2 = 5 \text{ kg}$

Centre of mass of pendulum rises to a height

$h = 10 \text{ cm} = 0.1 \text{ m}$

Speed of the bullet $= u_1$

Pendulum is at rest $\therefore u_2 = 0$

Common velocity of the bullet and the pendulum after the bullet is embeded into the object = v

$$\therefore v = \frac{m_1 u_1 + m_2 u_2}{m_1 + m_2}$$

$$v = \frac{0.02 \times u_1}{0.02 + 5} = \frac{0.02\, u_1}{5.02} \qquad ...(1)$$

From II equation of motion

$$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.1} = \sqrt{1.96} = 1.4 \text{ ms}^{-1}.$$

Substitute the value of v in equation (1)

$$1.4 = \frac{0.02\, u_1}{5.02}$$

$$\therefore u = \frac{5.02 \times 1.4}{0.02} = 351.4 \text{ ms}^{-1}.$$

In-Text Questions

1. State and prove the law of conservation of energy.

Ans. (i) When an object is thrown upwards its kinetic energy goes on decreasing and consequently its potential energy keeps increasing (neglecting air resistance).

Board Expected Questions

1. Deduce the relation between momentum and kinetic energy.

Ans. (i) Consider an object of mass m moving with a velocity $\vec{v}$. Then its linear momentum is $\vec{p} = m\vec{v}$ and its kinetic energy, KE $\frac{1}{2}mv^2$.

$$\text{KE} = \frac{1}{2}mv^2 = \frac{1}{2}m(\vec{v}.\vec{v}) \qquad ...(1)$$

(ii) Multiplying both the numerator and denominator of equation (1) by mass, m

$$\text{KE} = \frac{1}{2}\frac{m^2(\vec{v}.\vec{v})}{m} = \frac{1}{2}\frac{(m\vec{v}).(m\vec{v})}{m} \quad [\vec{p} = m\vec{v}]$$

$$= \frac{1}{2}\frac{\vec{p}.\vec{p}}{m} = \frac{\vec{p}^2}{2m}$$

$$\text{KE} = \frac{p^2}{2m}$$

(iii) where $|\vec{p}|$ is the magnitude of the momentum. The magnitude of the linear momentum can be obtained by

$$|\vec{p}| = p = \sqrt{2m(\text{KE})}$$

(iv) Note that if kinetic energy and mass are given, only the magnitude of the momentum can be calculated but not the direction of momentum. It is because the kinetic energy and mass are scalars.

2. What is a perfect inelastic collision? Derive the expression of the common velocity after collision.

Ans. (i) In a perfectly inelastic or completely inelastic collision, the objects stick together permanently after collision such that they move with common velocity.

UNIT-5 MOTION OF SYSTEM OF PARTICLES AND RIGID BODIES

Textbook Questions

1. Explain the types of equilibrium with suitable examples.

Ans. **Translational equilibrium** *[GMQP-2018]*

(i) Linear momentum is constant.

(ii) Net force is zero.

Rotational equilibrium

(i) Angular momentum is constant.

(ii) Net torque is zero.

Static equilibrium

(i) Linear momentum and angular momentum are zero.

(ii) Net force and net torque are zero.

Dynamic equilibrium

(i) Linear momentum and angular momentum are constant.

(ii) Net force and net torque are zero.

Stable equilibrium

(i) Linear momentum and angular momentum are zero.

(ii) The body tries to come back to equilibrium if slightly disturbed and released.

(iii) The center of mass of the body shifts slightly higher if disturbed from equilibrium.

(iv) Potential energy of the body is minimum and it increases if disturbed.

Unstable equilibrium

(i) Linear momentum and angular momentum are zero.

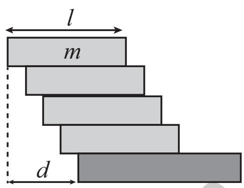
(ii) The body cannot come back to equilibrium if slightly disturbed and released.

(iii) The center of mass of the body shifts slightly lower if disturbed from equilibrium.

(iv) Potential energy of the body is not minimum and it decreases if disturbed.

NUMERICAL PROBLEMS :

1. **On the edge of a wall, we build a brick tower that only holds because of the bricks' own weight. Our goal is to build a stable tower whose overhang d is greater than the length *l* of a single brick. What is the minimum number of bricks you need?**



(Hint: Find the center of mass for each brick and add.)

Ans. Since the blocks are identical, the centre of mass of each block is located at its midpoint. Let us take the origin to be at the midpoint [or centre of mass] of block at the bottom and find out the shift in the position of centre of mass of the stack on the addition of the block each time.

The stack will not fall over till the shift in the position of its centre of mass is less than l/2 cm.

When the stack contains two blocks: if Δx_1 and Δx_2 are the shifts in the positions of the centre of the mass of the blocks with respect to origin then shift in the position of the centre of mass of the stack

$$\Delta X = \frac{M\Delta x_1 + M\Delta x_2}{M+M} = \frac{M[\Delta x_1 + \Delta x_2]}{2M}$$

$$\Delta X = \frac{\Delta x_1 + \Delta x_2}{2}$$

Here Δx_1=0 and $\Delta x_2 = d$ cm

Therefore, $\Delta X = 0 + \frac{d}{2} = \frac{d}{2}$ cm

Here: If $\frac{d}{2}$ cm $< \frac{1}{2}$ cm

Then the stack will not fall over.

In the above way,

Suppose that let the maximum *n* block can be stacked before the stack falls over. If Δx_1, Δx_2 , Δx_3 .....,Δx_n are the shifts in the position of the n blocks then shift in the position of the centre of mass of the stack

(iv) **With point of contact as reference:**

We can also arrive at the same expression by taking the momentary rotation happening with respect to the point of contact (another approach to rolling). If we take the point of contact as O, then,

$$KE = \frac{1}{2} I_o \omega^2$$

(v) Here, I_o is the moment of inertia of the object about the point of contact. By parallel axis theorem, $I_o = I_{CM} + MR^2$. Further we can write,

$I_o = MK^2 + MR^2$. With $v_{CM} = R\omega$ or $\omega = \frac{v_{CM}}{R}$

$$KE = \frac{1}{2}(MK^2 + MR^2)\frac{v^2_{CM}}{R^2}$$

$$KE = \frac{1}{2} Mv^2_{CM}\left(1 + \frac{K^2}{R^2}\right)$$

(vi) KE in pure rolling can be determined by any one of the following two cases.

(a) The combination of translational motion and rotational motion about the center of mass. (or)

(b) The momentary rotational motion about the point of contact.

Board Expected Questions

1. State in the absence of any external force the velocity of the centre of mass remains constant.

Ans. (i) When a rigid body moves, its center of mass will also move along with the body. For kinematic quantities like velocity (v_{CM}) and acceleration (a_{CM}) of the center of mass, we can differentiate the expression for position of center of mass with respect to time once and twice, respectively. For simplicity, let us take the motion along X direction only.

VOLUME - II

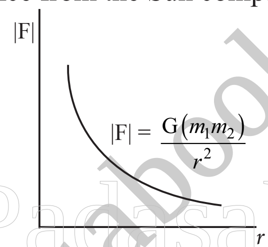
UNIT-6 GRAVITATION

1. Discuss the important features of the law of gravitation.

Ans. **Important features of gravitational force:**

(i) As the distance between two masses increases, the strength of the force tends to decrease because of inverse dependence on r^2. Physically it implies that,

(ii) Eg: The planet Uranus experiences less gravitational force from the Sun than the Earth since Uranus is at larger distance from the Sun compared to the Earth.



Variation of gravitational force with distance

(iii) The gravitational forces between two particles always constitute an **action–reaction pair**. It implies that the gravitational force exerted by the Sun on the Earth is always towards the Sun. The reaction force is exerted by the Earth on the Sun. The direction of this reaction force is towards Earth.

(iv) The torque experienced by the Earth due to the gravitational force of the Sun is zero given by

$$\vec{\tau} = \vec{r} \times \vec{F} = \vec{r} \times \left(-\frac{GM_S M_E}{r^2}\hat{r}\right) = 0$$

$$\text{Since } \vec{r} = r\hat{r},\ (\hat{r} \times \hat{r}) = 0$$

$$\text{So, } \vec{\tau} = \frac{d\vec{L}}{dt} = 0.$$

Numerical Problems:

1. An unknown planet orbits the Sun with distance twice the semi major axis distance of the Earth's orbit. If the Earths time period is T , what is the time period of this unknown planet?

Solution:

The earth's time period = T_1

Semi major axis distance of earth = a_1

Time period of unknown planet = T_2

Semi major axis of unknown planet = $2a_1$

Kepler's III law

$T^2 \propto a^3 \qquad \therefore T_1^2 \propto a_1^3 \;\&\; T_2^2 = 8a_1^3$

$$\frac{T_1^2}{T^2} = \frac{a_1^3}{8a_1^3} = \frac{1}{8}$$

$$8\,T_1^2 = T_2^2$$

$$\therefore \quad T_2 = 2\sqrt{2}\,T_1$$

2. Assume that you are in another solar system and provided with the set of data given below consisting of the planets' semi major axes and time periods. Can you infer the relation connecting semi major axis and time period?

Planet (imaginary)	Time period (T) (in year)	Semi major axis (a) (in AU)
Kurinji	2	8
Mullai	3	18
Marutham	4	32
Neithal	5	50
Paalai	6	72

Solution:

For planet kurinji

Time period $T_1^2 \propto a_1^3 \qquad T_1 = 2 \,;\, a_1 = 8$

$a_1 = 2^2, 2 \Rightarrow 2.T_1^2$

Similarly for other planets

$a_2 = 3^2, 2 \Rightarrow 2.T_2^2$

The mass of the Earth $M_e = 5.9 \times 10^{24}$ kg

The gravitational potential energy U = ?

$$U = -\frac{GM_eM_s}{R}$$

$$= -\frac{6.67\times10^{-11}\times5.9\times10^{24}\times1.9\times10^{30}}{1.5\times10^{12}}$$

$$U = -4.985 \times 10^{31} \text{ J}$$

$$\text{P.E U} = -49.84 \times 10^{32}$$

$$\therefore \text{T.E} = \text{P.E} + \text{K.E} = -49.84 \times 10^{32} + 26.55 \times 10^{32}$$

$$\text{T.E} = -23.29 \times 10^{32} \text{ J}$$

In-Text Questions

1. Drive the relation between *g* and Gravitational constant.

Ans. The gravitational force exerted by Earth on the mass *m* near the surface of the Earth is given by

$$\vec{F} = -\frac{GmM_e}{R_e^2}\hat{r}$$

Now equating Gravitational force to Newton's second law,

$$ma = -\frac{GmM_e}{R_e^2}\hat{r}$$

Hence, acceleration is,

$$\vec{a} = -\frac{GM_e}{R_e^2}\hat{r}$$

The acceleration experienced by the object near the surface of the Earth due to its gravity is called acceleration due to gravity. It is denoted by the symbol *g*. The magnitude of acceleration due to gravity is

$$|g| = \frac{GM_e}{R_e^2}$$

It is to be noted that the acceleration experienced by any object is independent of its mass. The value of *g* depends only on the mass and radius of the Earth.

Board Expected Questions

1. Explain the freely falling apple on Earth using the concept of gravitational potential V(*r*)?

Ans. The gravitational potential V (*r*) at a point of height *h* from the surface of the Earth is given by,

$$V(r = R + h) = \frac{GM_e}{(R+h)}$$

The gravitational potential V(*r*) on the surface of Earth is given by,

$$V(r = R) = \frac{GM_e}{R}$$

Thus we see that

$$V(r = R) < V(r = R + h)$$

Gravitational potential energy near the surface of the Earth at height *h* is *mgh*. The gravitational potential at this point is simply V(*h*) = U(*h*)/*m* = *gh*. In fact, the gravitational potential on the surface of the Earth is zero since *h* is zero. So the apple falls from a region of a higher gravitational potential to a region of lower gravitational potential.

Higher Order Thinking Skills (HOTS)

1. Draw graphs showing the variation of acceleration due to gravity with (i) height above the earth's surface (ii) depth below the earth's surface.

Solution:

(i) The value of *g* varies with height *h* as

$$g \propto \frac{1}{(R+h)^2} \quad \text{or} \quad g \propto \frac{1}{r^2}$$

Unit-7 Properties of matter

Textual Questions

1. State Hooke's law and verify it with the help of an experiment.

Ans. (i) Hooke's law is for a small deformation, when the stress and strain are proportional to each other.

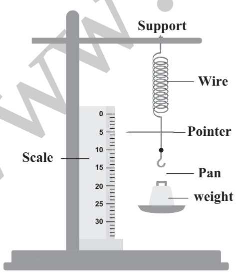
(ii) It can be verified in a simple way by stretching a thin straight wire (stretches like spring) of length L and uniform cross-sectional area A suspended from a fixed point O.

(iii) A pan and a pointer are attached at the free end of the wire as shown in Figure (a).

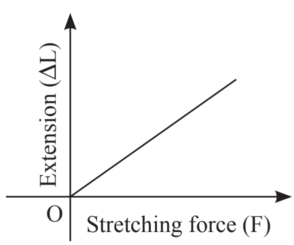
(iv) The extension produced on the wire is measured using a vernier scale arrangement. The experiment shows that for a given load, the corresponding stretching force is F and the elongation produced on the wire is ΔL.

(v) It is directly proportional to the original length L and inversely proportional to the area of cross section A. A graph is plotted using F on the X-axis and ΔL on the Y-axis (Figure b).

(vi) This graph is a straight line passing through the origin.



(a) Experimental



(b) variation of ΔL with F

T - surface tension

In case of soap bubbles,

The excess pressure of air inside them is doubled due to the presence of two interfaces are inside and one outside.

$$\Delta P_b = \frac{4T}{R}$$

Excess pressure of air inside the bigger bubble

$$\Delta P_b = \frac{4T}{4} = T$$

Excess pressure of air inside the smaller bubble

$$\Delta P_s = \frac{4s}{R} = \frac{4T}{2} = T$$

Air pressure difference between the smaller bubble and the atmosphere will be equal to the sum of excess pressure inside the bigger and smaller bubbles.

$$\text{Pressure different } \Delta P = \Delta P_b + \Delta P_s$$
$$= T + 2T = 3T$$

Excess pressure inside a single soap bubble

$$= \frac{4T}{R} = \frac{4T}{4} = 2T$$

$\therefore$ Pressure difference of single soap bubble less than radius of both $T < 3T$

In-Text Questions

1. Write any two applications of Bernoulli's Theorem.

Ans. **(a) Blowing off roofs during wind storm**

(i) In olden days, the roofs of the huts or houses were designed with a slope.

(ii) One important scientific reason is that as per the Bernoulli's principle, it will be safeguarded except roof during storm or cyclone.

(2) This temperature assumes that the water has one atmosphere of pressure pushing down on it. When this pressure is decreased the temperature at which water can boil will decrease.

(3) To look at is another way, we can at water at the (simplified) molecular level.

(iv) Bubbles can form and rise since the vapor pressure can overcome atmospheric pressure liquid turning into bubbles and escaping as it boils.

Board Expected Questions

1. What is latent heat? Give its units. With the help of a suitable graph, explain the terms latent heat of fusion and latent heat of vaporisation.

Ans. **Latent heat:**

The amount of heat transferred per unit mass during the change of phase of a substance without any change in its temperature is called latent heat of the substance for particular change.

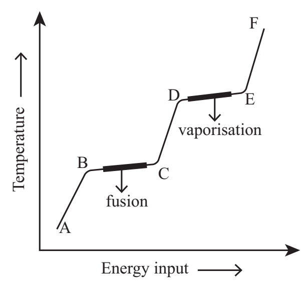
Latent heat is denoted by L and having SI unit J kg^{-1}.

(i) **Latent heat of fusion:**

It is latent heat for solid–liquid state change. It is denoted by L_f and is given by

Latent heat of fusion, $L_f = \dfrac{Q}{m}$

Its SI unit is J kg^{-1}



(ii) **Latent heat of vaporisation:**

It is in latent heat for liquid-gas state change. It is denoted by L_v and often refferred to as heat of fusion and heat of vaporisation. It is given by

Latent heat of vaporisation, $L_V = \dfrac{Q}{m}$ and its SI unit is J kg^{-1}

Starting a point A, the substance is in its solid phase, heating it brings the temperature up to its melting point but the material is still a solid at point B. As it is heated further, the energy from the heat source goes into breaking the bonds holding the atoms is place.

This takes place from B to C. At point C all of the solid phase has been transformed into the liquid phase. Once again, as energy is added the energy goes into the kinetic energy of the particles raising the temperature, (C to D). At point D the temperature has reached its boiling point but it is still in the liquid phase. From points D to E thermal energy is overcoming the bonds and the particles have enough kinetic energy to escape from the liquid, the substance is entering the gas phase.

Beyond E, further heating under pressure can raise the temperature still further is how a pressure cooker works.

Higher Order Thinking Skills (HOTS)

1. A light rod of length 2m is suspended horizontally by means of 2 vertical wires of equal lengths tied to its ends. One of the wires is made of steel & is of cross section $A_1 = 0.1 cm^2$ & other of brass & is of cross section $A_2 = 0.2 cm^2$, find out the position along the rod at which a weight must be suspended to produce (i) equal stresses in both wires, (ii) equal strains in both wires for steel, $y = 20 \times 10^{10}$ Nm^{-2} & for brass $y = 10 \times 10^{10}$ Nm^{-2} .

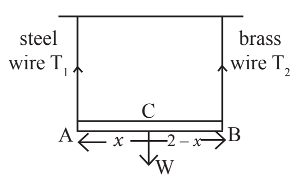
Solution:

The situation in diagram

Let A & B be a rod of length 2m suppose a weight W is hung at C at a distance x from A. Let T_1 & T_2 be the tension in the steel & brass rods.

(i) stress in steel wire $= \dfrac{T_1}{A_1}$

stress in brass wire $= \dfrac{T_2}{A_2}$



as both the stresses are equal, so

$$\frac{T_1}{A_1} = \frac{T_2}{A_2} \text{ or } \frac{T_1}{T_2} = \frac{A_1}{A_2} = \frac{0.1}{0.2} = \frac{1}{2}$$

UNIT-8 HEAT AND THERMODYNAMICS

Textual Questions

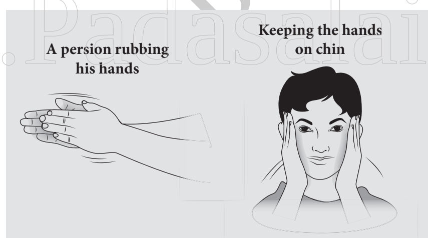
1. **Explain the meaning of heat and work with suitable examples.**

***Ans.* Meaning of heat and work :**

(i) When hands are rubbed against each other the temperature of the hands increases. Some work is done on hands by rubbing.

(ii) The temperature of the hands increases due to this work. Now if the hands are placed on the chin, the temperature of the chin increases. This is because the hands are at higher temperature than the chin.

(iii) In the above example, the temperature of hands is increased due to work and temperature of the chin is increased due to heat transfer from the hands to the chin.



Difference between work and heat

(iv) By doing work on the system, the temperature in the system will increase and sometimes may not. Like heat, work is also not a quantity and through the work energy is transferred to the system .

(v) Either the system can transfer energy to the surrounding by doing work on surrounding or the surrounding may transfer energy to the system by doing work on the system.

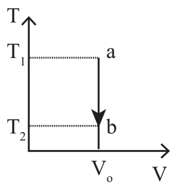
(vi) For the transfer of energy from one body to another body through the process of work, they need not be at different temperatures.

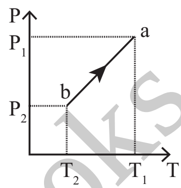
NUMERICAL PROBLEMS :

1. Draw the TP diagram (P-x axis, T-y axis), VT(T-x axis, V-y axis) diagram for
a. Isochoric process
b. Isothermal process
c. Isobaric process

Solution:

a. Isochoric $\Rightarrow V = V_0 = \text{constant}$





$T(V) = \text{multivalued}$ $\qquad P(T) = \dfrac{nRT}{V_0}$

$a = (P_1, V_0, T_1)$ $\qquad b = (P_2, V_0, T_2)$

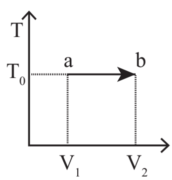
$$PV_0 = nRT$$

b. Isothermal $\Rightarrow T = T_0 = \text{constant}$

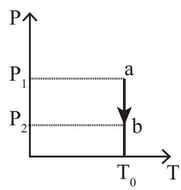
$PV = nRT_0$

$a = (P_1, V_1, T_0)$ $\qquad b = (P_2, V_2, T_0)$

$$PV = nRT$$



$T(V) = T_0$



$P(T) = \text{multivalued}$

c. Isobaric $\Rightarrow P = P_0 = \text{constant}$

$a = (P_0, V_1, T_1)$ $\qquad b = (P_0, V_2, T_2)$

$$P_0V = nRT$$

In-Text Questions

1. Distinguish between isothermal and adiabatic process.

Ans.

	Isothermal	Adiabatic
1.	Temperature remains constant $\Delta T = 0$.	Heat content remains constant $\Delta Q = 0$.
2.	Walls of the container is perfectly conductivity.	All walls and piston are perfectly an insulating.
3.	The changes occur slowly i.e. slow process.	The changes occur suddenly i.e. a fast process.
4.	Internal energy remains constant, i.e. $\Delta U = 0$.	Internal energy changes $\Delta U \neq 0$
5.	p_v = constant	p_v^{γ} = constant
6.	Slope of isothermal curve on p_v dig. $\frac{-p}{v} = \frac{dp}{dv}$ (–ve slope)	Slope is $\frac{-\gamma p}{v}$ $\gamma > 1$ Slope of adiabatic greater than isothermal.

Numerical Problems :

1. What amount of heat must be supplied to 2.0×10^{-2} kg of nitrogen (at room temperature) to raise its temperature by 45°C at constant pressure? (Molecular mass of N_2 = 28, R = 8.3 J mol^{-1} k^{-1})

Solution:

The mass of the gas = 2.0×10^{-2} kg
= 20 g

This mass of the gas is equivalent to $\frac{20}{28}$ mole $= \frac{5}{7}$ mole

UNIT-9

KINETIC THEORY OF GASES

Textual Questions

1. Write down the postulates of kinetic theory of gases.

Ans. (i) All the molecules of a gas are identical, elastic spheres.

(ii) The molecules of different gases are different.

(iii) The number of molecules in a gas is very large and the average separation between them is larger than size of the gas molecules.

(iv) The molecules of a gas are in a state of continuous random motion.

(v) The molecules collide with one another and also with the walls of the container.

(vi) These collisions are perfectly elastic so that there is no loss of kinetic energy during collisions.

(vii) Between two successive collisions, a molecule moves with uniform velocity.

(viii) The molecules do not exert any force of attraction or repulsion on each other except during collision. The molecules do not possess any potential energy and the energy is wholly kinetic.

(ix) The collisions are instantaneous. The time spent by a molecule in each collision is very small compared to the time elapsed between two consecutive collisions.

(x) These molecules obey Newton's laws of motion even though they move randomly.

2. Derive the expression of pressure exerted by the gas on the walls of the container.

Ans. **Expression for pressure exerted by a gas :**

(i) Consider a monoatomic gas of N molecules each having a mass *m* inside a cubical container of side l as shown in the figure (a).

In-Text Questions

1. Derive Meyer's relation.

Ans. Consider μ mole of an ideal gas enclosed in a cylinder provided with a frictionless piston of area A.

P – pressure of gas

V – volume of gas

T – absolute temperature gas

dQ – quantity of heat supplied

To keep the volume of the gas constant a small w_t is placed over the piston.

The pressure and temperature increase to $p + dp$ and T + dt.

dQ is used to increase the internal energy dU of the gas. But the gas does not do any work [$dw = 0$]

$\therefore dQ = dU = 1 \times c_v \times dT.$

Now the w_t is removed. The piston now moves upwards thus' a dist. dx, the pres. of the enclosed gas equal to atmosphere pressure P. Due to expansion, temperature decreases.

Now a quantity of heat dQ' is supplied till its temperature become T + ΔT. This heat energy is not only used to increase the internal energy dU of the gas but also to do exists work dW in moving the piston upwards.

$\therefore dQ^1 = dU + dW$

At constant pressure

$dQ^1 = c_p\, dT$

$\therefore c_p\, dT = c_v\, dT + dW$

work done dW = Force × distance

= P × A × dx

$dW = p.\, dv$ [A. $dx = dv$ change in volume]

$$\therefore c_p\, dT = c_v\, dT + pdv \qquad (1)$$

The equation of state of an ideal gas is

$pv = RT$

Difference both the sides

$$pdv = \mathrm{R}d\mathrm{T} \qquad (2)$$

Substitute (2) in (1)

$$c_p\, d\mathrm{T} = c_v\, d\mathrm{T} + \mathrm{R}d\mathrm{T}$$

$$c_p = c_v + \mathrm{R}$$

$$\therefore c_p - c_v = \mathrm{R}.$$

This equation is known as Meyer's electron.

Higher Order Thinking Skills (HOTS)

1. An air bubble of volume 1.0 cm^3 rises from the bottom of a lake 40 *m* deep at a temperature of 12°C. To what volume does it grow when it reaches the surface which is at a temperature of 35°C?

Solution:

Volume of the air bubble $V_1 = 1.0\ \mathrm{cm}^3 = 10^{-6}\ \mathrm{m}^3$

Temperature, $T_1 = 12°C \Rightarrow T_1 = 273\ \mathrm{K} + 12°C = 285\ \mathrm{K}.$

Temperature, $T_2 = 35°C \Rightarrow T_2 = 273\ \mathrm{K} + 35°C = 308\ \mathrm{K}.$

Pressure on bubble p_1 = Water pressure + Atmospheric pressure.
$= 4.93 \times 10^5$ pa

$$\therefore \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{(4.93\times10^5)\times(1\times10^{-6})\times308}{258\times(1.01\times10^5)}$$

$$= \frac{4.93\times308\times10^{-6}\times10^5\times10^{-5}}{285\times1.01}$$

$$= \frac{4.93\times308\times10^{-6}}{285\times1.01} = \frac{1.518.44\times10^{-6}}{287.85}$$

$$= 5.275\times10^{-6}\,\mathrm{m}^3$$

$$\therefore V_2 = 5.3 \times 10^{-6}\mathrm{m}^3$$

★ ★ ★

UNIT-10 OSCILLATIONS

Textual Questions

1. What is meant by simple harmonic oscillation? Give examples and explain why every simple harmonic motion is a periodic motion whereas the converse need not be true.

Ans. (i) Simple harmonic motion is a special type of oscillatory motion in which the acceleration or force on the particle is directly proportional to its displacement from a fixed point and is always directed towards that fixed point.

(ii) In one dimensional case, let x be the displacement of the particle and a_x be the acceleration of the particle, then

$a_x \propto x$

$a_x = -\,b\,x$

where b is a constant which measures acceleration per unit displacement and dimensionally it is equal to T^{-2}.

(iii) Multiplying by mass of the particle on both sides of equation and from Newton's second law, the force is

$F_x = -\,k\,x$

where k is a force constant which is defined as force per unit length.

(iv) The negative sign indicates that displacement and force (or acceleration) are in opposite directions.

(v) This means that when the displacement of the particle is taken towards right of equilibrium position (x takes positive value), the force (or acceleration) will point towards equilibrium (towards left) and similarly, when the displacement of the particle is taken towards left of equilibrium position (x takes negative value), the force (or acceleration) will point towards equilibrium (towards right).

Numerical Problems :

1. Consider the Earth as a homogeneous sphere of radius R and a straight hole is bored in it through its centre. Show that a particle dropped into the hole will execute a simple harmonic motion such that its time period is $T = 2\pi\sqrt{\frac{R}{g}}$

Solution:

Earth is assumed to be a homogeneous sphere Its centre is at O and Radius = R.

The hole is bored straight through the centre along its diameter.

The acceleration due to gravity at the surface of the earth = g

Mass of the body dropped inside the hole = m

After time t, the depth it reached (inside the earth) = d

The value of 'g' decreases with deportation so acceleration due to gravity at deportation.

So acceleration due to gravity at deportation = g'

$$g' = g(1 - d/R) = g\left(\frac{R - d}{R}\right) \quad ...(1)$$

Let y be the distance from the centre of the earth

Then y = Radius – distance = R – d

Substitute y in (1)

$g' = g\,y/R$

Now, force on the body of mass m due to this new acceleration g′ will be

$F = mg' = mgy\,/R$

Radius × distance and this force is directed towards the mean position O.

The body dropped in the hole will execute S.H.M

Spring factor $k = mg$/Radius

$$T = 2\pi\sqrt{\frac{\text{Inertial factor}}{\text{spring}}} = 2\pi\sqrt{\frac{m}{mg/R}} = 2\pi\sqrt{\frac{R}{g}}$$

and

average Potential energy = <Potential energy>

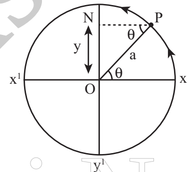
$$= \frac{1}{T}\int_0^T (\text{Potential energy})\, dt.$$

In-Text Questions

1. Explain Displacement, velocity in SHM, and derive special cases.

Ans. **Displacement in SHM:**

The distance travelled by the vibrating particle at any instant of time t from its mean position is known as displacement. When the particle is at p, the displacement of the particle along y axis is y.



Displacement in SHM.

The in Δ OPN, $\sin\theta = \frac{ON}{OP}$

ON = y = OP sin θ

y = OP sin wt (∵ θ = wt)

Since OP = a, the radius of the circle, the displacement of the vibrating particle is

$$y = a \sin wt. \quad ...(1).$$

The amplitude of the vibrating particle is defined as its maximum displacement from the mean position.

Velocity in SHM:

The rate of change of displacement is the velocity of the vibrating particle.

Differentiating equation (1) with respect to time t.

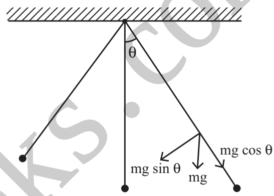
$$\frac{dy}{dt} = \frac{d}{dt}(a \sin wt) \quad ...(2)$$

$$\therefore v = a\, w \cos t\, wt$$

Board Expected Questions

1. Consider a simple pendulum, having a bob attached to a string, that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on its length (*l*), mass of the bob (*m*), and acceleration due to gravity (*g*). Derive the expression for its time period using method of dimension.

Ans. (i) Let θ be the angle made by the string with vertical. When the bob is at the mean position θ = 0.



(ii) There are two forces acting on the bob. The tension T along the vertical force due to gravity (= *mg*).

(iii) The force can be resolved into *mg* cos θ along a circle of length L and centre at this support point.

(iv) Its radial acceleration (w^2L) and also tangential acceleration. So net radial force = T – *mg* cos θ, while the tangential acceleration provided by *mg* sin θ. Since the radial force gives zero torque.

(v) So torque provided by the tangential component.

$$\tau = Lmg \sin\theta$$

$\tau = I\alpha$ (by Newton's law of rotational motion)

$I\alpha = mg \sin\theta \, L$

$$\alpha = \frac{mgL}{I}\sin\theta.$$

Where I is the moment of inertia, α is angular acceleration,

(vi) The θ is to small,

$$\sin\theta = \theta$$

$$\alpha = -\frac{mgL}{I}\theta \; ; \; w = \sqrt{\frac{I}{mgL}}$$

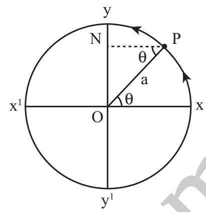
[for simple harmonic α (*t*) = $-w^2 t$ × θ is small] and

$$T = 2\pi\sqrt{\frac{I}{mgL}} \qquad \left[\because w = \frac{2\pi}{T}\right].$$

2. Show that the projection of uniform circular motion on a diameter is SHM.

Ans. Consider a particle moving along the y circumference of a circle of radius a and NP centre O, with uniform speed v, in anticlockwise direction.

Let xx^1 and yy^1 be the two perpendicular x diameters. Suppose the particle is at P after a time t. If w is the angular velocity then the angular displacement θ in time t is given by $\theta = -wt$.



Projection of uniform circular motion

From P draw PN perpendicular to yy^1. As the particles moves from x to y, foot of the perpendicular N moves from O to y. As it moves further from y to x^1, then from x^1 to y^1 and back again to x, the point N moves from y to O, from O to y^1 and back again to O. When the particle completers one revolution along the circumference, the point N completes one vibration about the mean position O. The motion of the point N along the diameter yy^1 is simple harmonic.

Hence the projection of a uniform circular motion on a diameter of side in simple harmonic motion.

Higher Order Thinking Skills (HOTS)

1. Two simple harmonic moles are represented by $y_1 = 0.1 \sin(100\pi t + \pi/3)$ and $y_2 = 0.1 \cos \pi t$. What is the phase difference of the velocity of the particle 1 with respect to the velocity of particle 2?

Ans. Velocity of particle 1

$$V_1 = \frac{dy_1}{dt} = 0.1 \cos\left(100\pi t + \frac{\pi}{3}\right) \times 100\pi$$

$$= 10\pi \cos\left(100\pi t + \frac{\pi}{3}\right)$$

Velocity of particle 2

$$V_2 = \frac{dy_2}{dt} = 0.1\,(-\sin \pi t) \times \pi$$

UNIT-11 WAVES

Textual Questions

1. Discuss how ripples are formed in still water.

Ans. A stone is dropped in a trough of still water, we can see a disturbance produced at the place where the stone strikes the water surface. This disturbance spreads out (diverges out) in the form of concentric circles of ever increasing radii (ripples) and strike the boundary of the trough. This is because some of the kinetic energy of the stone is transmitted to the water molecules on the surface. Actually the particles of the water (medium) themselves do not move outward with the disturbance. This can be observed by keeping a paper strip on the water surface. The strip moves up and down when the disturbance (wave) passes on the water surface. This shows that the water molecules only undergo vibratory motion about their mean positions.

2. Briefly explain the difference between travelling waves and standing waves.

Ans.

S. No	Travelling Waves (or) Progressive Waves	Standing Waves (or) Stationary Waves
1.	Crests and troughs are formed in transverse progressive waves, and compression and rarefaction are formed in longitudinal progressive waves. These waves move forward or backward in a medium i.e., they will advance in a medium with a definite velocity.	Crests and troughs are formed in transverse stationary waves, and compression and rarefaction are formed in longitudinal stationary waves. These waves neither move forward nor backward in a medium, i.e., they will not advance in a medium.

$f_{new} = \frac{1}{4} f$

Intensity $I_{new} = ?$

$I = 2\pi^2 \rho v f^2 A^2$

$I_{old} \propto f^2 A^2$

$I_{new} \propto \frac{1}{6} f^2 A^2$

$I_{new} \propto \frac{1}{4} I_{old}$

$I \propto \frac{A^2}{f^2}$

$I_{new} \propto \frac{(2A)^2}{\left(\frac{1}{4} f\right)^2}$

$I_{new} \propto \frac{4A^2}{\left(\frac{1}{16} f\right)^2}$

$I_{new} \propto I_{old}$

Board Expected Questions

1. Write Characteristics of progressive waves.

Ans. (i) Particles in the medium vibrate about their mean positions with the same amplitude.

(ii) The phase of every particle ranges from 0 to 2π.

(iii) No particle remains at rest permanently. During wave propagation, particles come to the rest position only twice at the extreme points.

(iv) Transverse progressive waves are characterized by crests and troughs whereas longitudinal progressive waves are characterized by compressions and rarefactions.

(v) When the particles pass through the mean position they always move with the same maximum velocity.

(vi) The displacement, velocity and acceleration of particles separated from each other by $n\lambda$ are the same, where n is an integer, and λ is the wavelength.

Higher Order Thinking Skills (HOTS)

1. Discuss the effect of density, humidity and wind.

Ans. **Effect of density :** Consider two gases with different densities having same temperature and pressure. Then the speed of sound in the two gases are

$$v_1 = \sqrt{\frac{\gamma_1 P}{\rho_1}} \qquad \text{..... (1)}$$

and

$$v_2 = \sqrt{\frac{\gamma_2 P}{\rho_2}} \qquad \text{..... (2)}$$

Taking ratio of equations (1) and (2), we get

$$\frac{v_1}{v_2} = \frac{\sqrt{\frac{\gamma_1 P}{\rho_1}}}{\sqrt{\frac{\gamma_2 P}{\rho_2}}} = \sqrt{\frac{\gamma_1 \rho_2}{\gamma_2 \rho_1}}$$

For gases having same value of γ,

$$\frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}} \qquad \text{..... (3)}$$

Thus the velocity of sound in a gas is inversely proportional to the square root of the density of the gas.

Effect of moisture (humidity) : The density of moist air is 0.625 of that of dry air, which means the presence of moisture in air (increase in humidity) decreases its density. Therefore, speed of sound increases with rise in humidity. From equation

$$v = \sqrt{\frac{\gamma P}{\rho}} = \sqrt{\gamma c T}\ .$$

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

Let ρ_1, v_1 and ρ_2, v_2 be the density and speeds of sound in dry air and moist air, respectively. Then

$$\frac{v_1}{v_2} = \frac{\sqrt{\frac{\gamma_1 P}{\rho_1}}}{\sqrt{\frac{\gamma_2 P}{\rho_2}}} = \sqrt{\frac{\rho_2}{\rho_1}} \text{ if } \gamma_1 = \gamma_2$$

Since P is the total atmospheric pressure, it can be shown that

$$\frac{\rho_2}{\rho_1} = \frac{P}{p_1 + 0.625 p_2}$$

where p_1 and p_2 are the partial pressures of dry air and water vapour, respectively. Then

$$v_1 = v_2 \sqrt{\frac{P}{p_1 + 0.625 p_2}}$$

Effect of wind : The speed of sound is also affected by blowing of wind. In the direction along the wind blowing, the speed of sound increases whereas in the direction opposite to wind blowing, the speed of sound decreases.

★★★